

# TRADE TRAINING ATC PROGRAMME

## ELECTRICIAN GENERAL

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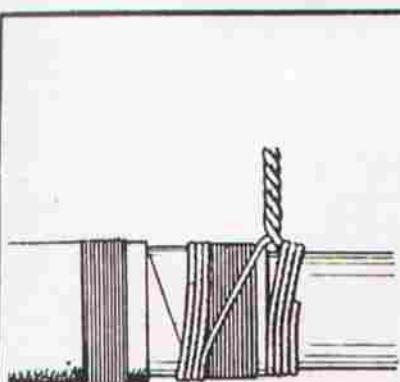
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PUNJAB BOARD OF TECHNICAL EDUCATION  
TRADE TESTING CELL, LAHORE.

T.T.P. Series No. 22

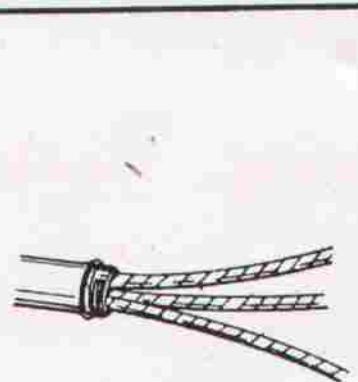
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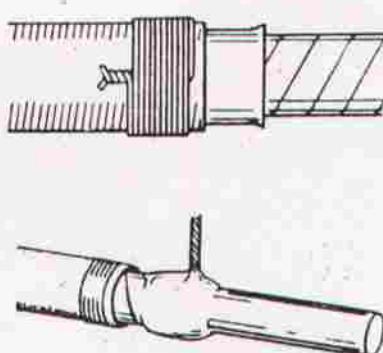
مزید کتب پڑھنے کے لئے آج ہی رزٹ کریں : [www.iqbalkalmati.blogspot.com](http://www.iqbalkalmati.blogspot.com)



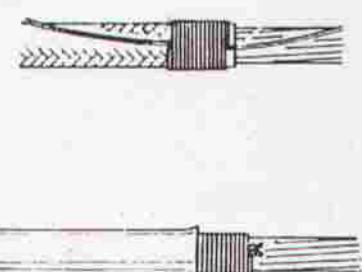
1 STRIPPING



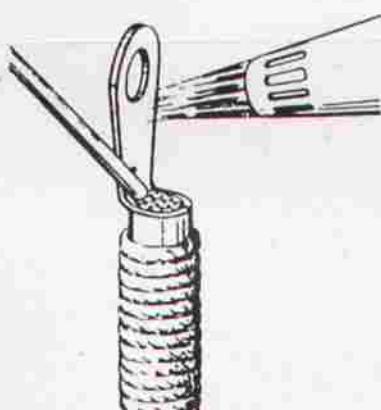
2 STRIPPING



3 INSTRUCTION SHEET



4 INSTRUCTION SHEET



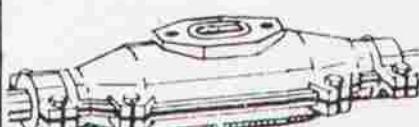
5 SOLDERING



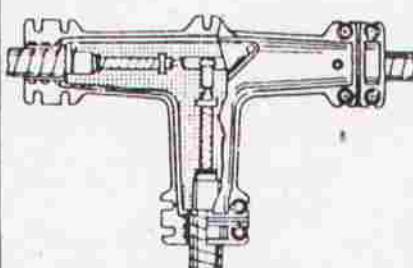
6 WELDING



7 TERMINAL BOX



8 CABLE BOX



9 CABLE DISTR. PLUG

LAYOUT

EP 2.1/3.5.5/  
Cable jointing



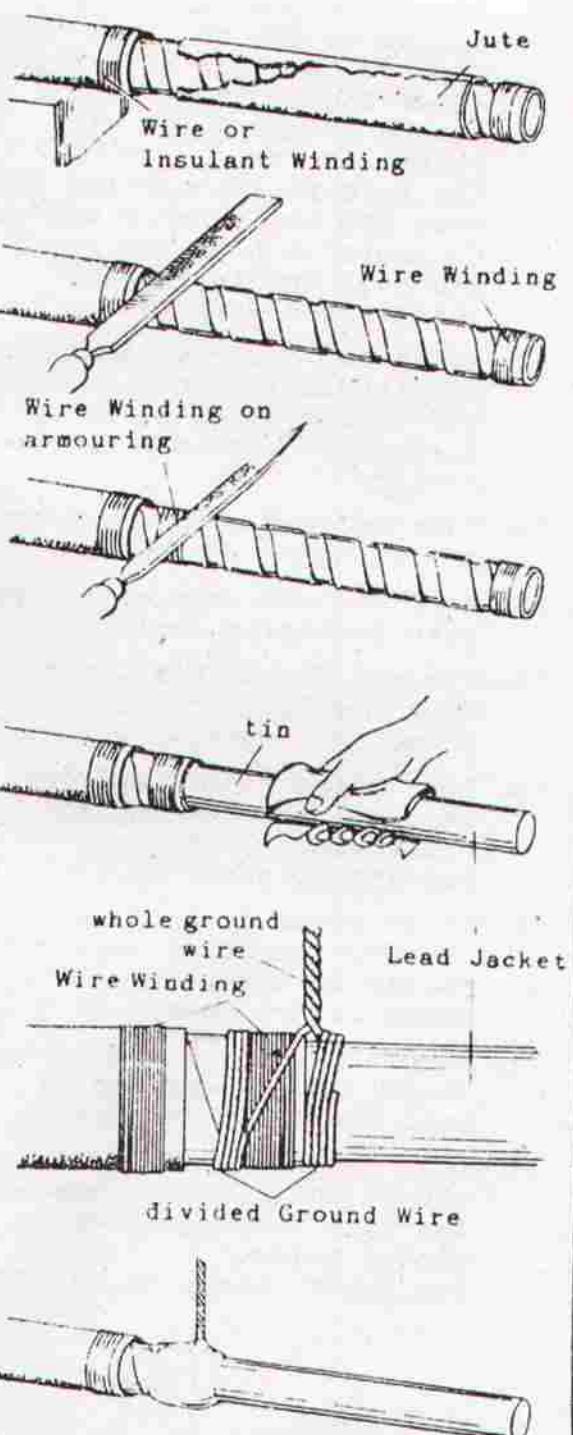
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

SEQUENCE OF OPERATION

1. In order to ease working and ensure greater reliability, place end of cable on some suitable support (e.g. trestle), and mark the length to be off-set.
2. Secure jute with wire or insulant winding.  
See instr. sheet No. EP/2.3/3 5 5/3
3. Incise and peel jute sheathing.
4. File steel-tape armouring bare for 20 to 30 mm and tin.
5. Place wire winding on tinned steel-tape armouring (some 10 windings).
6. Incise armouring in front of winding by filing all around with triangular file and remove by knicking.  
Note: Saw must not be used.
7. Heat with blow-lamp and peel-off the impregnated and well-adhesive paper sheath. (e.g. with petroleum)
8. Scrape bare and tin lead jacket for some 20 to 30 mm next to wire winding.
9. Loop one half of ground wire in 2 windings around armouring and lead jacket.
10. Join the three windings by bead soldering.  
See instr. sheet No. EP/2.3/3 5 5/3



## STRIPPING OF ARMoured CABLES

EP 2.3/3.5.5/1

Cable jointing



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

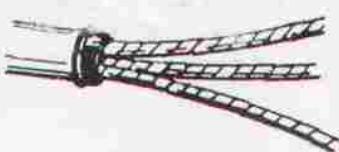
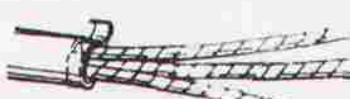
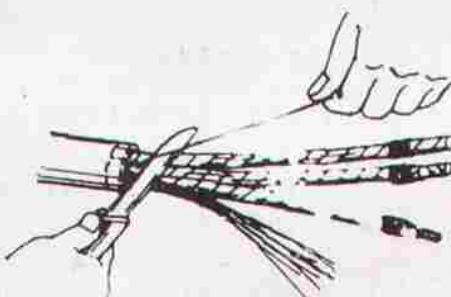
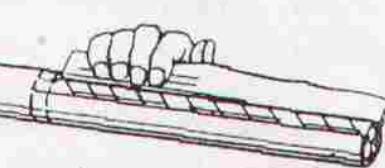
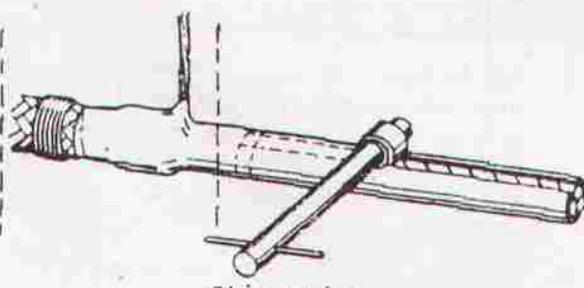
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN

GENERAL

SEQUENCE OF OPERATION

11. Notch the lead sheath all around to the required length, then notch again all around according to the set-off length of the joint wire sheath (belt). The lead sheath section between the two notches serves as protection of the remaining belt and is removed later. (see Step 18)
12. Crack two closely parallel longitudinal cracks and reel off intermediate strip with flat-nosed pliers or strip reeler.
13. Turn up lead sheath and tear off at notch (do not cut).
14. Reel off and tear off joint wire sheathing (belt).
15. Cut off filler with knife from inside to outside. Do not cut against wires.
16. Lace wires with (impregnated) twine according to connecting length. See instr. sheet No. 2.3/3.5.5/4
17. Strip wires to windings, whereby the outer layers should be notched and the inner layers torn.
18. Remove remaining lead sheath (belt) and expand end of lead sheathing to funnel.
19. Lace exposed joint wire sheathing (belt) by winding with (impregnated) binder twine. See instr. sheet No. 2.3/3.5.5/4

**STRIPPING OF ARMoured CABLES**

EP 2.3/3.5.5/2

Cable jointing



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

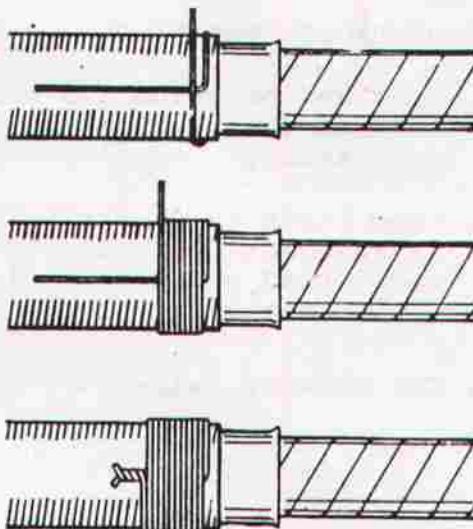
ELECTRICIAN

GENERAL

### WIRE WINDINGS

#### SEQUENCE OF OPERATION

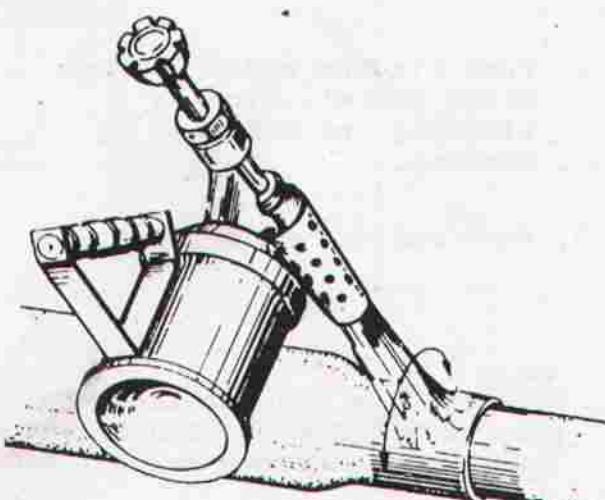
1. Bend wire right angularly and loop around the cable.
2. Wind several layers tightly and securely over loop.
3. Twist and cut wire ends.



### TINNING OF LEADEN WORK-PIECES

#### SEQUENCE OF OPERATION

1. Clean and scrape work-pieces bare.
2. Spread flux on work-piece.
3. Heat carefully while moving flame back and forth (simultaneously).
4. Melt solder (rod tin).
5. Heat the applied solder only to a pasty condition (it must not flow) and spread with flux-soaked cloth.



#### Note

The back and forth movement of the flame during the heating of the work-piece is necessary for preventing localized overheating (melting of the lead).

### INSTRUCTION SHEET

EP 2.3/3.5.5/3

Cable jointing



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

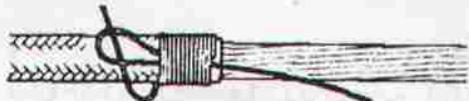
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GENERAL

### TWINE WINDING WITH THREADED END

#### SEQUENCE OF OPERATION

1. Loop end of twine and start winding just before end of insulation.
2. Loop twine in several closely adjacent firm windings and thread end through loop.
3. Cut ends of twine.



### TWINE WINDING WITH KNOTTED END

#### SEQUENCE OF OPERATION

1. Crease end of twine and wind some three layers around crease.
2. Push winding under knurled cable jacket, tighten slightly and continue winding.
3. Knot and cut ends.



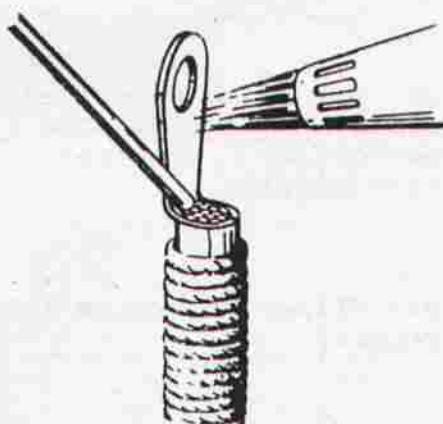
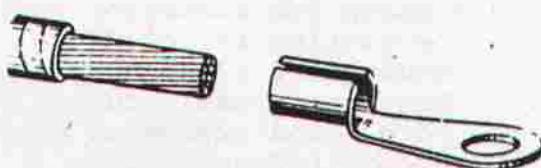
#### Note:

Windings are made of tape, twine or wire, depending on the purpose and composition of the line to be laced. They must be smooth and uniform, firm and unshiftable.

	INSTRUCTION SHEET	EP 2.3/3.5.5/4
		Cable jointing
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL
		6

SEQUENCE OF OPERATION

1. Strip line to required length (= length of sleeve + 10 mm);  
Clean conductor if necessary.
2. Push stripped end into the sleeve.
3. Protect insulation from soldering heat, e.g. by lacing with asbestos yarn.
4. Put cable and cable-lug in vertical position.
5. Coat soldering point with paste flux.
6. Solder, heat cable-lug above the soldering point, permit solder to penetrate into sleeve by knocking.
7. Insulate and secure and protect by lacing, if this should be required.



Note:

The solder must fill the sleeve of the cable-lug completely, but must not penetrate any further.

Only solders containing a minimum of 40% tin should be used.

MOUNTING LARGE CABLE-LUGS  
BY SOLDERING

EP 2.3/3.5.5/5

Cable jointing



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN

GENERAL

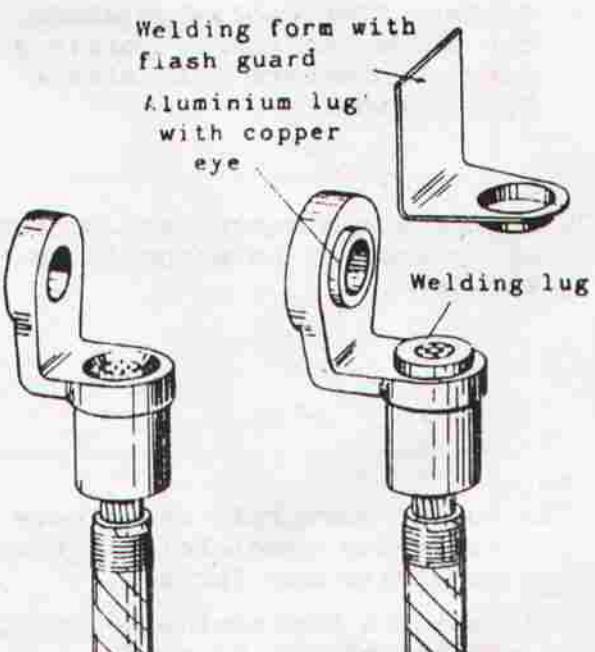
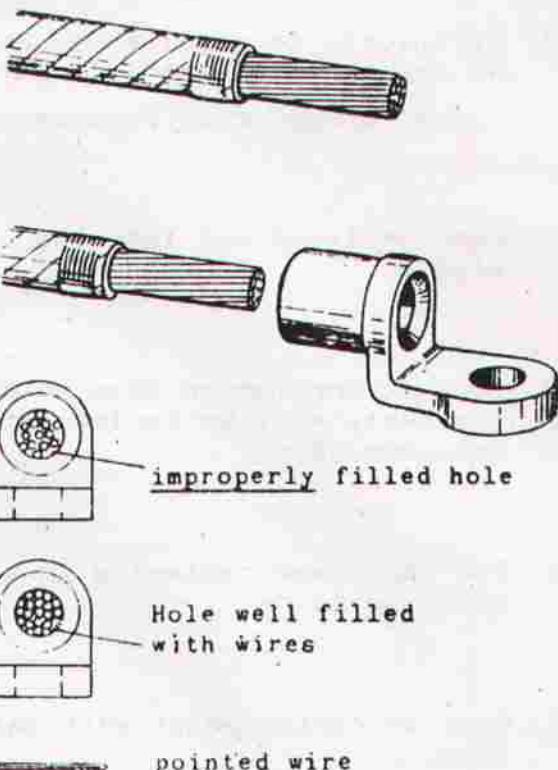
The Preliminaries for welding cable-lugs on aluminium conductors require particularly meticulous execution, so as to ensure that the actual welding be rapid and reliable.

Working Steps

1. Set-off and strip cables to required length and form out the conductors.
2. Smooth cut conductor ends by cutting followed by subsequent cleaning (use benzine on cable cores). Form round segmental conductor beforehand.
3. Attach cable-lugs. Fill hole of cable-lug with pointed wires from waste conductor ends completely.
4. Place conductor and cable-lug in vertical position, and attach welding form with flash guard if this is required.
5. Coat points to be welded with suitable flux. The flux must not be hygroscopic after cooling.
6. Coat filler with flux and prepare.

Note

The fillers used should preferably be waste ends of the cable core to be welded.



**WELDING CABLE-LUGS ON  
ALUMINIUM CONDUCTORS**

EP 2.3/3.5.5/6

Cable jointing



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

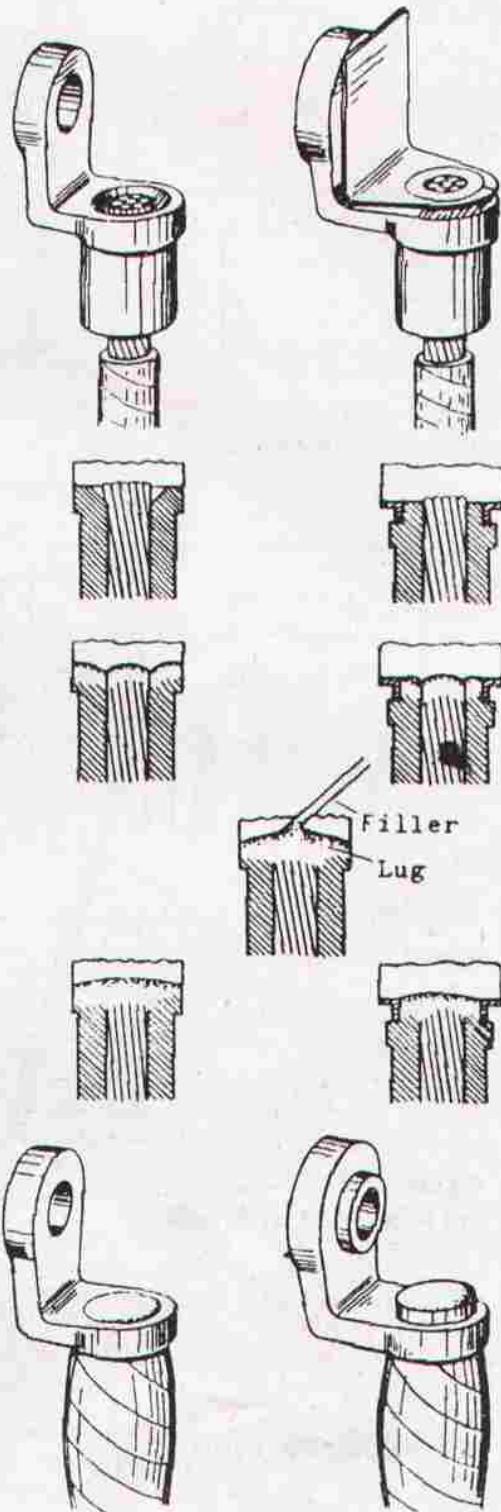
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL 8

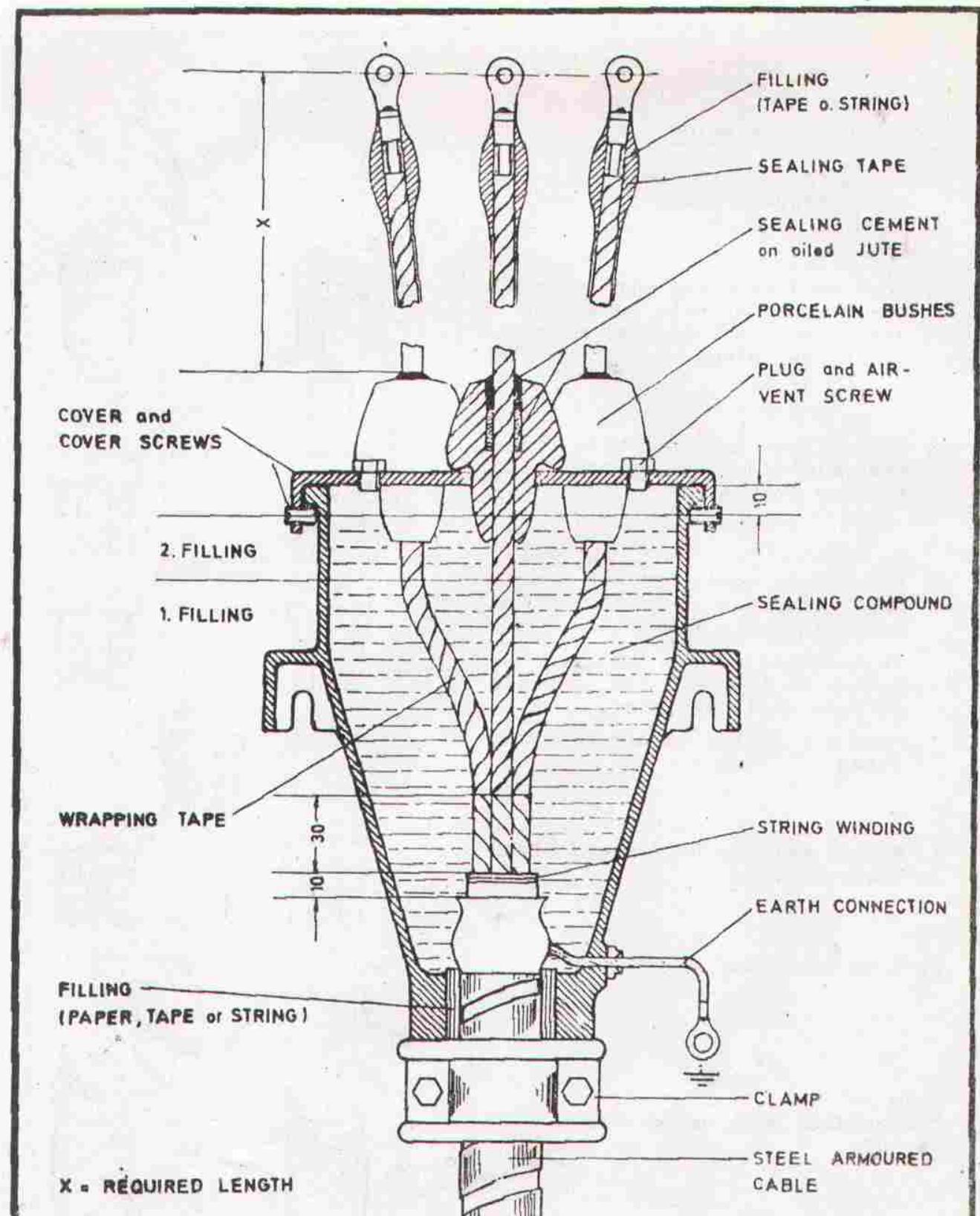
SEQUENCE OF OPERATION

1. Set welding flame pointedly and at low-oxygen (excess of gas).
2. Heat conductor end with pointed flame circulatingly until lugs are formed on the faces of the individual wires.
3. Spread lugs together with filler. Heat rim of cable-lug until its surface bulges.
4. Spread the conductor and lug melts together. Build up filler until a lug is formed.  
In building up the lug feed filler to the melt and continue to feed while stirring.  
Take off filler before removing flame.
5. Permit melt to harden and clean cable-lug.
6. Wrap cable end.

Note  
The welding must be performed rapidly.



	WELDING CABLE-LUGS ON ALUMINIUM CONDUCTORS	EP 2.3/3.5.5/7
		Cable jointing
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING	ELECTRICIAN
	PAK-GERMAN TECHNICAL TRAINING PROGRAMME	GENERAL



TERMINAL BOX

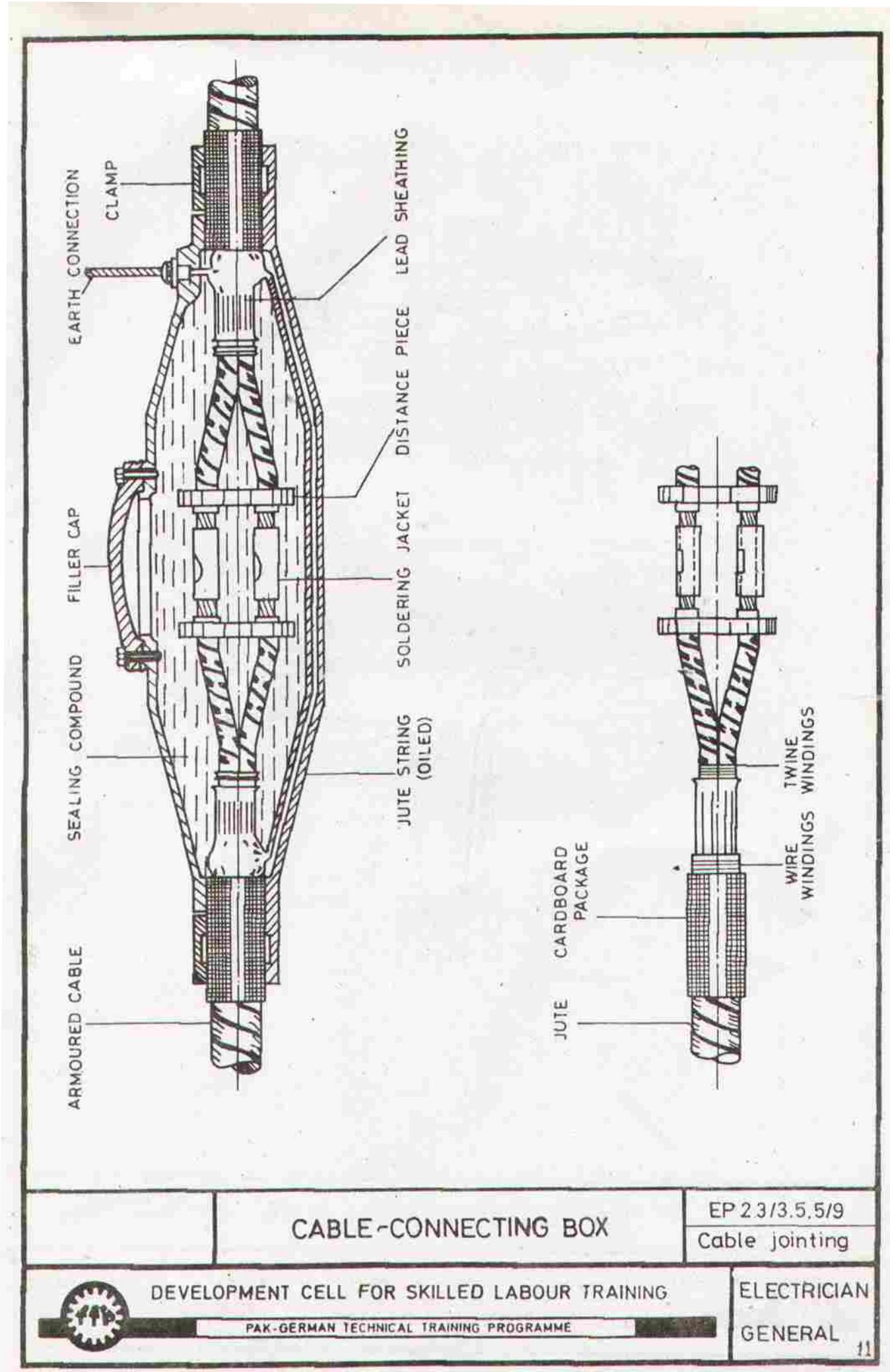
EP 2.3/3.5.5/8  
Cable jointing

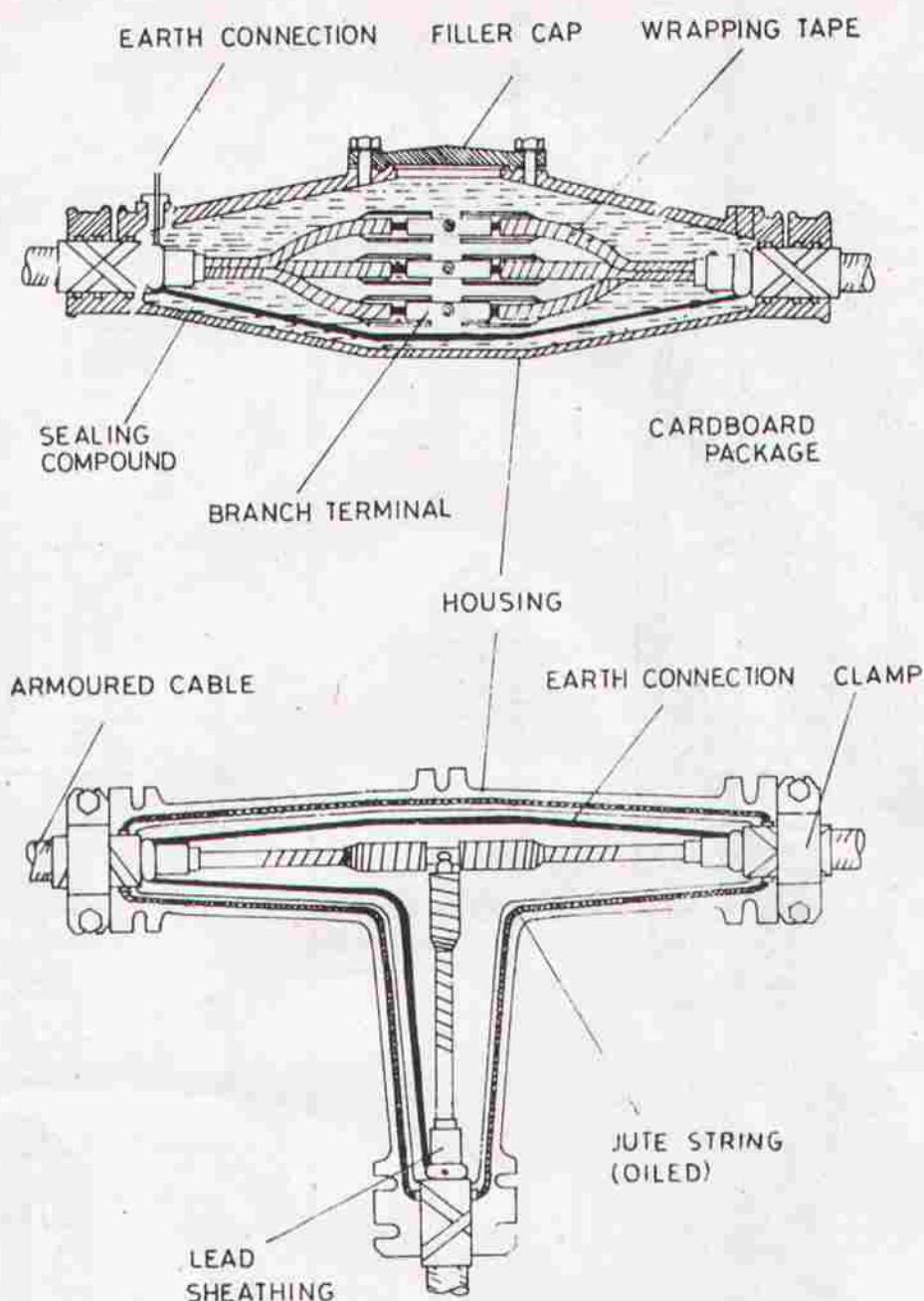


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL





CABLE DISTRIBUTION PLUG

EP 2.3/3.5.5/10

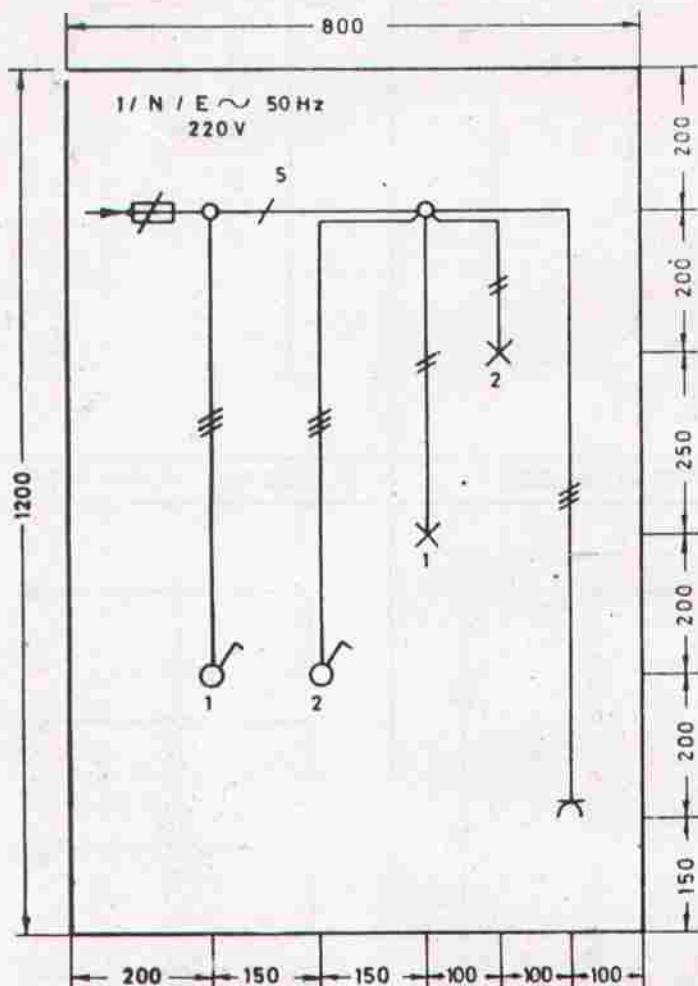
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING



PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

1 KITCHEN INSTALLATION	2 DRAWING ROOM INST.	3 SLEEPING ROOM INST.
4 HALL INSTALLATION	5 IMPULSE SWITCH INST.	6 TREMBLER BELL INST
7 TIME SWITCH INST.	8 INDICATOR BELL INST	9 TIMING SWITCH INST.
	LAYOUT	EP 2.1/3.5.4/ Installation II
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-G M&T TRAINING PROGRAMME	ELECTRICIAN GENERAL
		13



## Material:

- 1 Fuse, (complete)
- 2 Junction boxes
- 2 Lampholders
- 2 Single pole switches
- 1 Socket (Schuko or 3-pin)

## For Alteration:

- 2 Sockets (Schuko or 3-pin)

Use instead of

- 2 Single pole switches
- 1 Multicircuit switch

According to the type  
of installation

Screws, clamps, cables,  
pipes, wire, batten or  
casing and capping  
material

- a) CASING and CAPPING
- b) BATTEN WIRING
- c) PIPE WIRING
- d) CABLE WIRING

Estimate the material required for the installation

- a) Switch 1 operates lamp 1, switch 2 operates lamp 2
- b) Alteration, remove switch 1 + 2, replace number 1 with a  
multi-circuit switch, number 2 with a socket (Schuko or 3-pin)

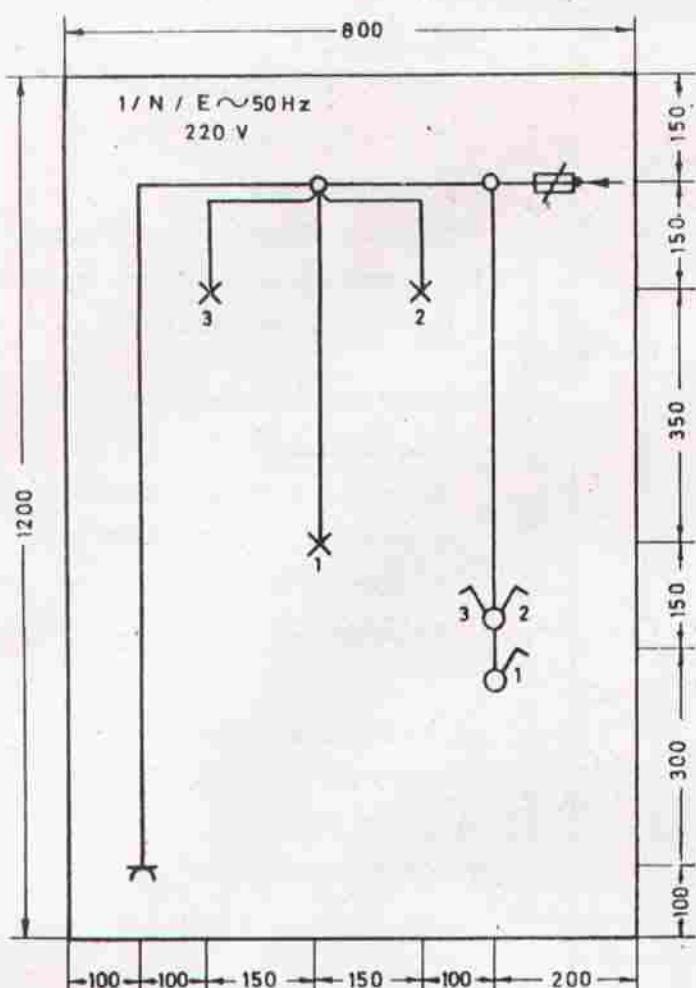
Draw complete wiring- and current path diagrams of above shown  
installation layout and alteration thereof.

DO NOT cut off spare wires in junction boxes, switches etc.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

	KITCHEN	EP 2.3/3.54/1 Installation II
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	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL
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#### MATERIAL:

1 Fuse, (complete)  
 2 Junction boxes  
 3 Lampholders  
 1 Socket (Schuko or 3-pin)  
 1 Single pole switch  
 1 Multicircuit switch  
 According to the type of  
 installation  
 Screws, clamps, cable,  
 pipes, wire, batten or  
 casing and capping  
 material

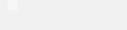
a) CASING and CAPPING  
 b) BATTEN WIRING  
 c) PIPE WIRING  
 d) CABLE WIRING

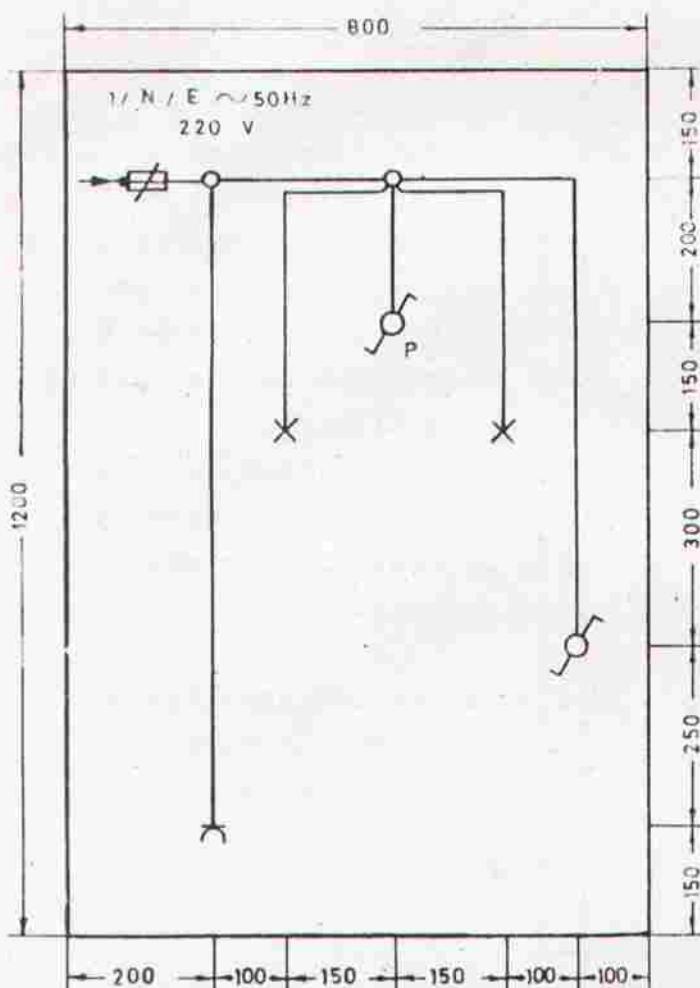
Indicate number of wires in above given installation layout.

Estimate the material required for the installation.

Draw complete wiring- and current path diagrams of above shown installation layout.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

	DRAWING/ LIVING ROOM	EP 2.3/3.5.4/2 Installation 11
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 15



## MATERIAL:

- 1 Fuse, (complete)
- 2 Junction boxes
- 2 Lampholders
- 1 Socket (Schuko or 3-pin).
- 1 Change-over switch (pull)
- 1 Change-over switch

According to the type of installation

Screws, clamps, cable, pipes, wire, batten or casing and capping material

- a) CASING and CAPPING
- b) BATTEN WIRING
- c) PIPE WIRING
- d) CABLE WIRING

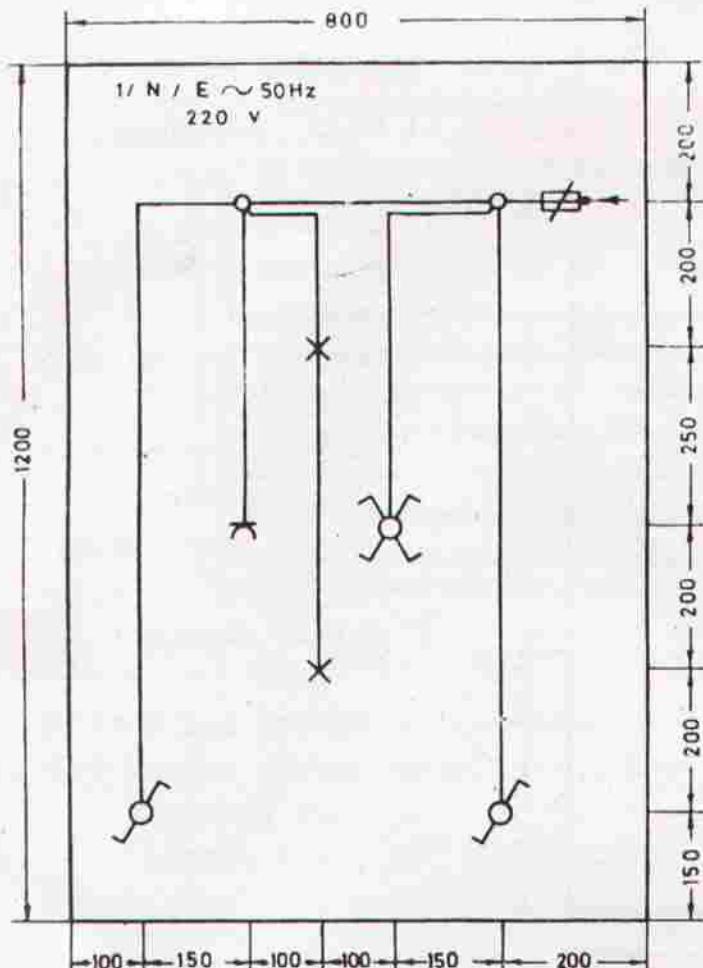
Indicate number of wires in above given installation layout.

Estimate the material required for the installation.

Draw complete wiring- and current path diagrams of above shown installation layout.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

	SLEEPING ROOM	EP 2.3/3.5.4/3 Installation II
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MATERIAL:

- 1 Fuse, (complete)
- 2 Junction boxes
- 2 Lampholders
- 2 Change-over switches
- 1 Intermediate switch
- 1 Socket (Schuko or 3-pin)
- According to the type of installation
  - Screws, clamps, cables, pipes, wire, batten or casing and capping material
- a) CASING and CAPPING
- b) BATTEN WIRING
- c) PIPE WIRING
- d) CABLE WIRING

Indicate number of wires (conductors) in above given installation layout.

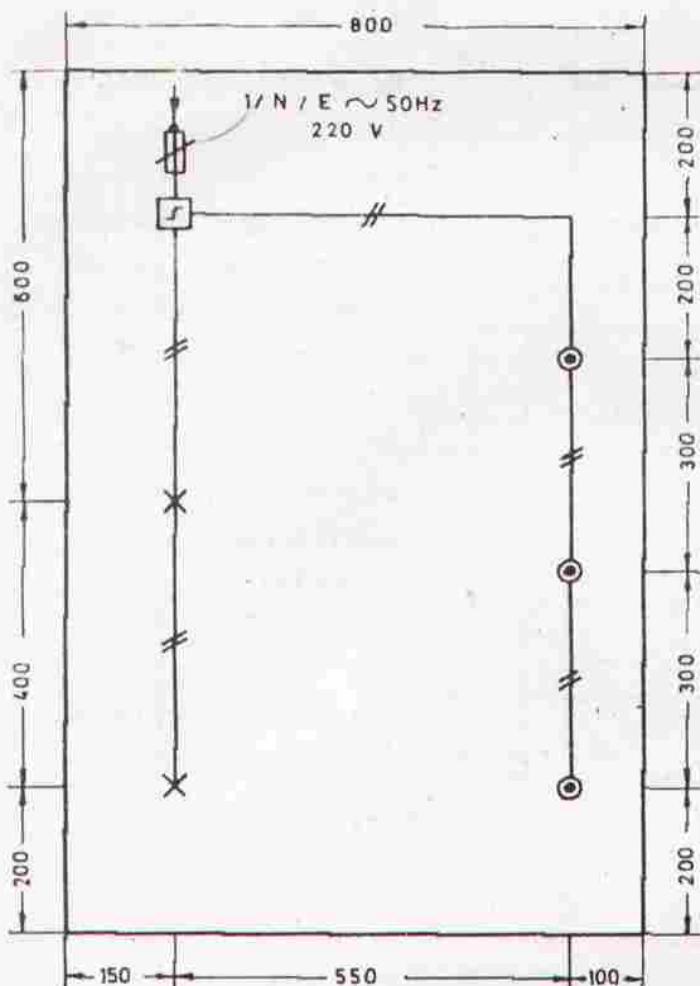
Estimate the material required for the installation.

Draw complete wiring- and current path diagrams of above shown installation layout.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

If intermediate switch is not available then perform practical exercise of Drg.No. EP/23/3.5.4/10

	HALL	EP23/3.5.4/4
		Installation II
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL
		17



### **MATERIAL:**

- 1 Fuse, (complete)
- 1 Impulse switch
- 2 Lampholders
- 3 Momentary contact switches

According to the kind of installation

- Screws, clamps, cable, pipe and wires, casing and capping material, batten material

a) CASING and CAPPING

b) BATTEN WIRING

c) PIPE WIRING

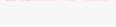
d) CABLE WIRING

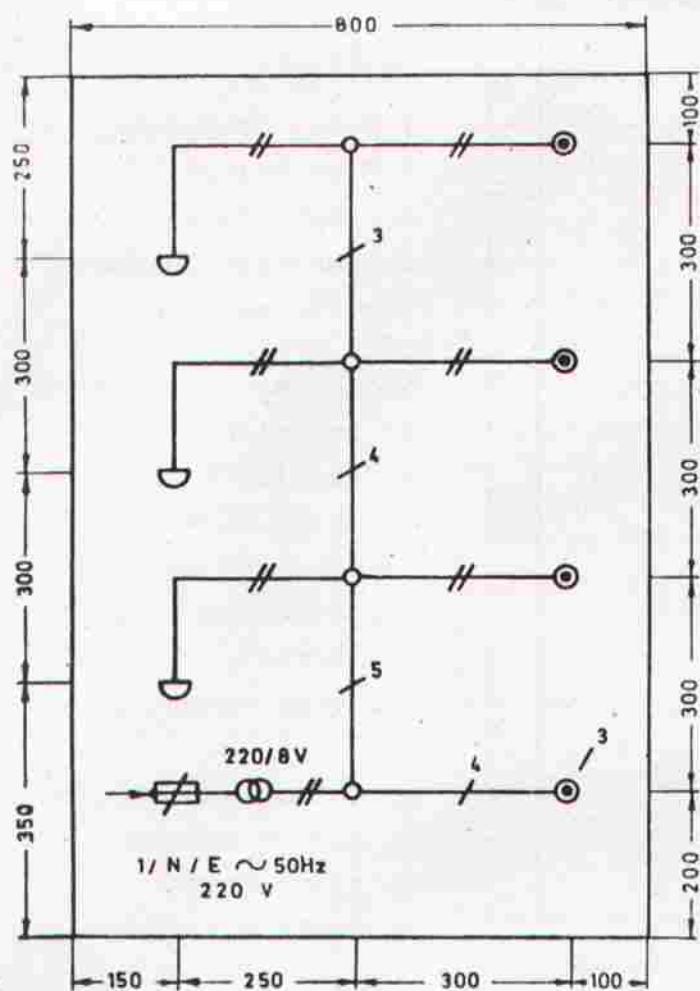
Estimate the material required for the installation to be made.

Draw complete wiring and current path diagrams of above shown installation layout.

Check and connect in PRESENCE of your INSTRUCTOR.

If impulse switch is not available then perform practical exercise of Drg.No. EP/1.2/3/5.4/11

	IMPULSE SWITCH	EP 2.3/3.5.4/5 Installation II
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL

MATERIAL:

1 Fuse, (complete)

1 Transformer 220/8 V

3 Trembler bells

3 Momentary contact switches, single

3 Momentary contact switches with name plate

According to the kind of installation

4 Junction boxes, screws, clamps, cable, pipes and wire, casing and capping material.

a) CASING and CAPPING

b) BATTEN WIRING

c) PIPE WIRING

d) CABLE WIRING

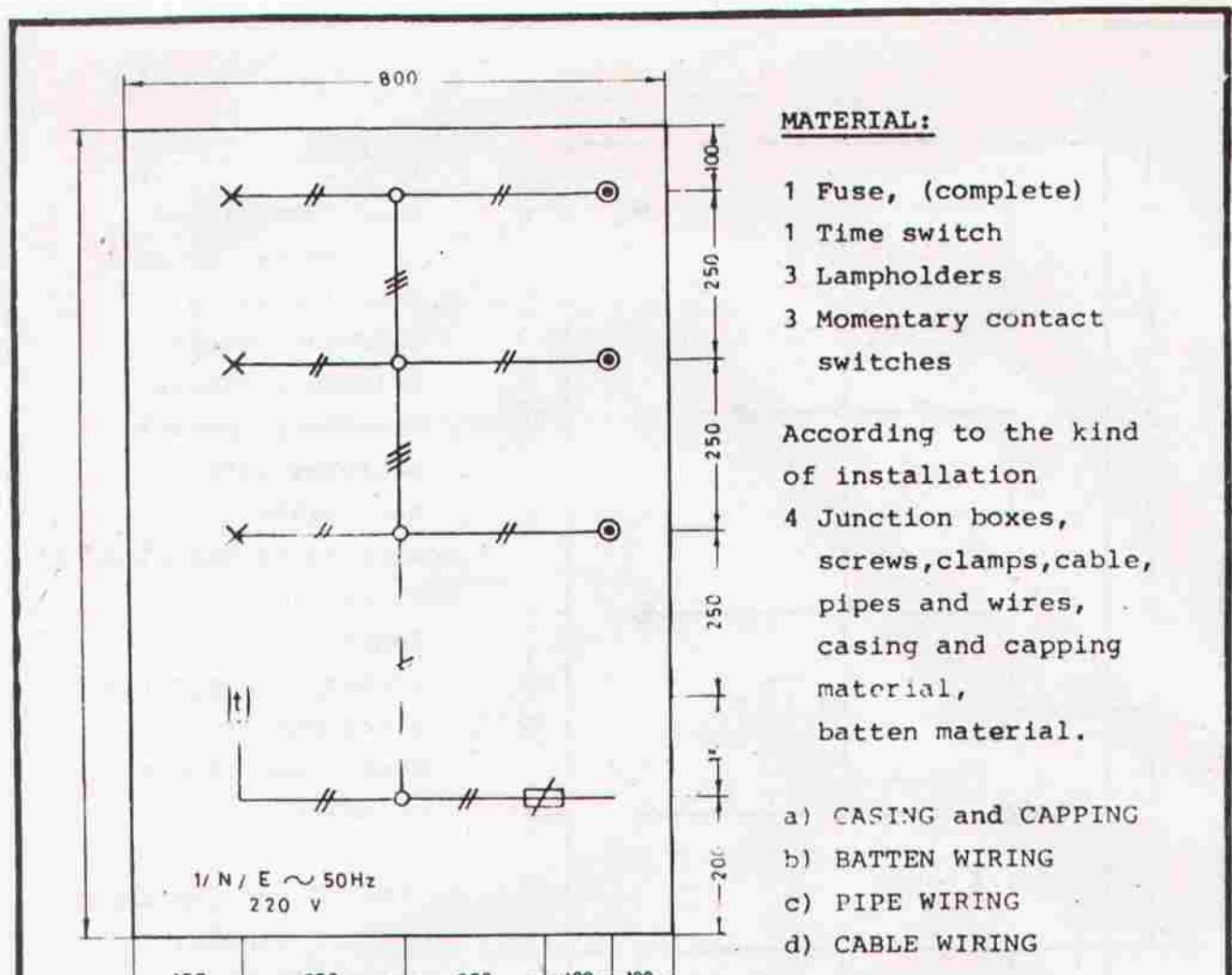
Estimate the material required for the installation to be made.

Draw complete wiring- and current path diagrams of above shown installation layout.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

If 8V bell is not available then perform this exercise without Transformer at 220V

	TREMBLER BELL	EP 2.3/3.5.4/6 Installation 11
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 19

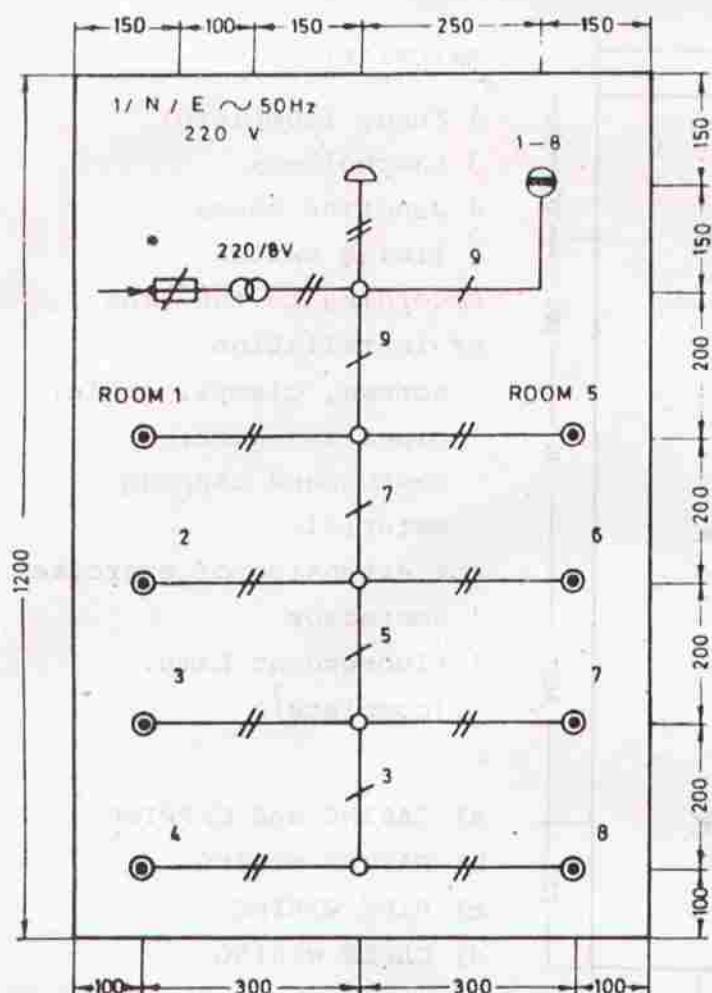


Estimate the material required for the installation to be made.

Draw complete wiring- and current path diagrams of above shown installation layout.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

	TIME SWITCH	EP 2.3/3.5.4/7 Installation II
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL
		20

MATERIAL:

1 Fuse, (complete)  
 1 Transformer 220/8 V  
 1 Number-Indicator 8 Nos.  
 1 Trembler bell  
 8 Momentary contact switches  
 According to the kind of installation  
 5 Junction boxes, screws, clamps, cable, pipes and wires, casing and capping material, batten material.

a) CASING and CAPPING  
 b) BATTEN WIRING  
 c) PIPE WIRING

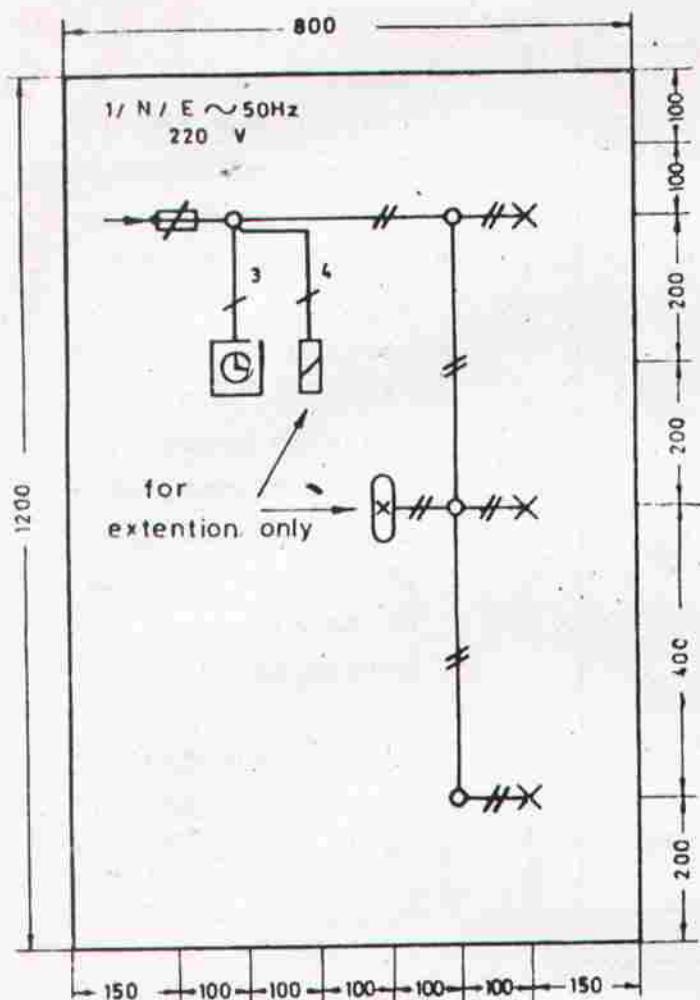
Estimate the material required for the installation to be made.

Draw complete wiring-and current path diagrams of above shown installation layout.

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

If 8V bell indicator is not available then perform this exercise without Transformer at 220V.

	INDICATOR BELL	EP 2.3/3.5.4/8 Installation II
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 21



#### MATERIAL:

1 Fuse, (complete)  
 3 Lampholders  
 4 Junction boxes  
 1 Timing switch  
 According to the kind  
 of installation  
 screws, clamps, cable,  
 pipes and wire,  
 casing and capping  
 material.

For extension of exercise

1 Contactor  
 1 Fluorescent Lamp,  
 (complete)

a) CASING and CAPPING  
 b) BATTEN WIRING  
 c) PIPE WIRING  
 d) CABLE WIRING

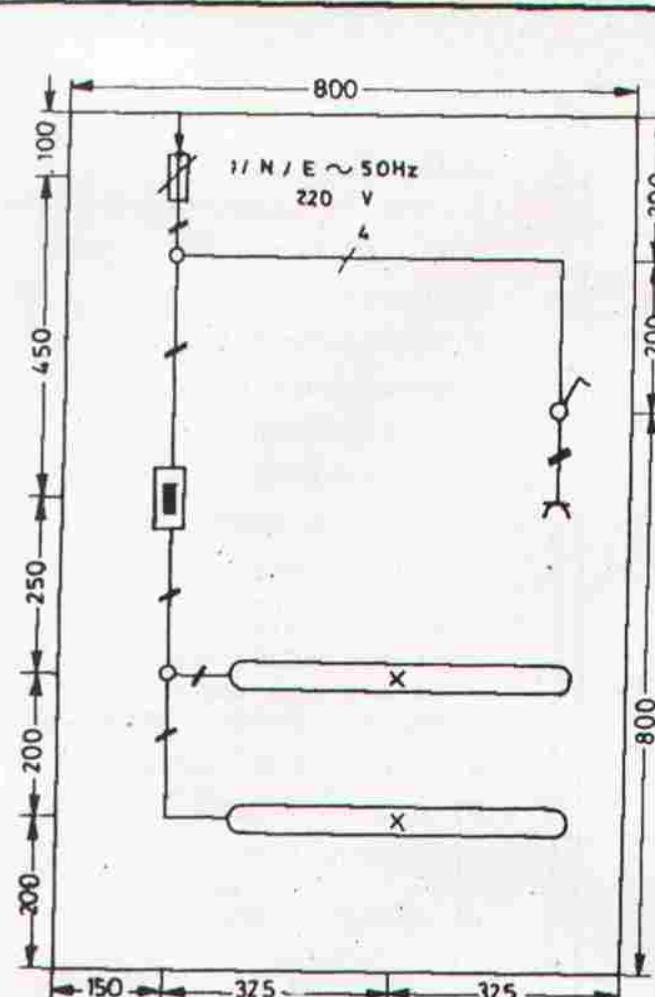
Estimate the material required for the installation to be made.

Draw complete wiring- and current path diagrams of above shown installation layout.

- a) without extension
- b) with extension

Check and connect SUPPLY in PRESENCE of your INSTRUCTOR.

	TIMING SWITCH	EP 2.3/3.5.4/9 Installation II
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 22



MATERIAL:

1 fuse (with base) complete  
 1 single pole switch  
 2 fluorescent tubes 20 W  
 2 pairs tube holders  
 1 ballast 40 W  
 2 starters 20 W  
 2 junction boxes  
 1 3-pin socket  
 2 round blocks  
 According to the type of installation  
 screws, clamps, cable, pipes and wires, casing and capping material, batten material

- a) CASING AND CAPPING
- b) BATTEN WIRING
- c) PIPE WIRING
- d) CABLE WIRING

Estimate the material required for the installation to be made

- a)
- b)
- c)
- d)

Draw complete WIRING- and CURRENT PATH DIAGRAM of above shown INSTALLATION-LAYOUT.

CHECK AND CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

**FLUORESCENT LAMPS  
WITH ONE BALLAST**

EP 2.3/3.5.4/10

Installation II

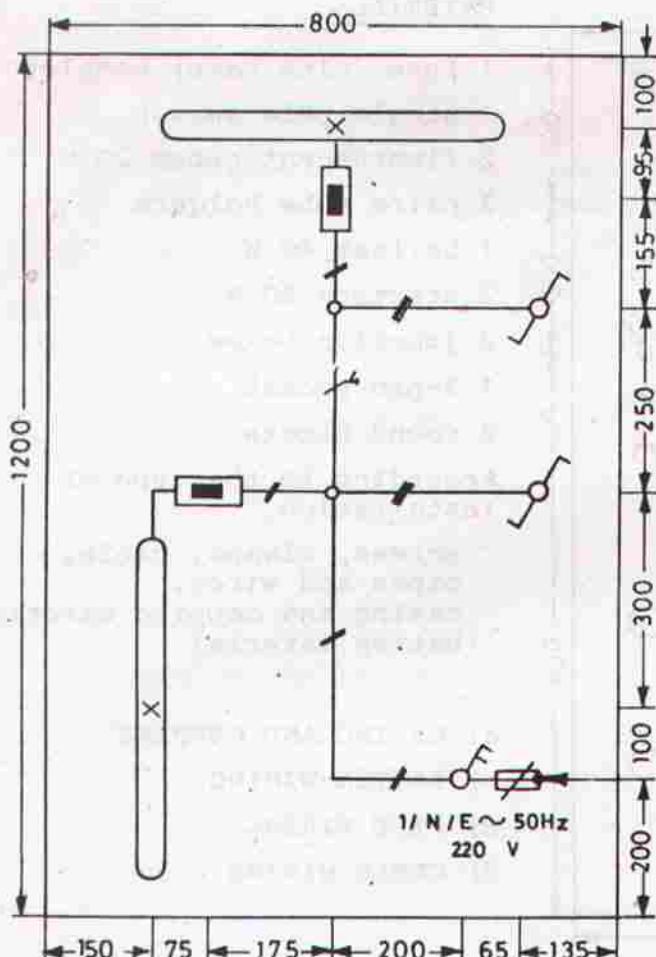
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

ELECTRICIAN

GENERAL



PAK-GERMAN TECHNICAL TRAINING PROGRAMME



MATERIAL:

- 1 fuse (with base) complete
- 1 two pole switch
- 2 change over switches
- 2 fluorescent tubes 20 W
- 2 pairs tube holders
- 2 ballasts 20 W
- 2 starters 20 W
- 2 junction boxes
- 3 round blocks
- screws, clamps, pipes and wires, casing and capping material, batten material
- a) CASING AND CAPPING
- b) BATTEN WIRING
- c) PIPE WIRING
- d) CABLE WIRING

Estimate the material required for the installation to be made

- a)
- b)
- c)
- d)

CHECK AND CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

FLUORESCENT LAMPS  
WITH TWO BALLAST

EP 2.3/3.5.4/11

Installation II

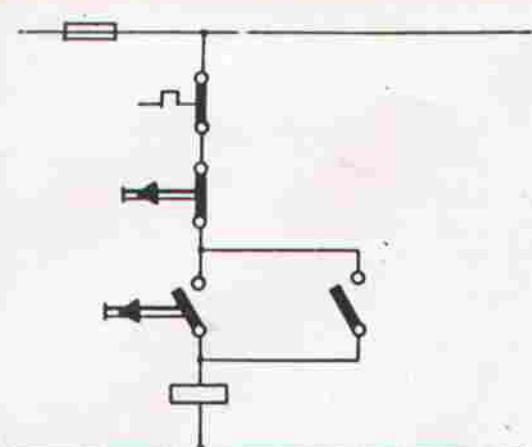
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

ELECTRICIAN

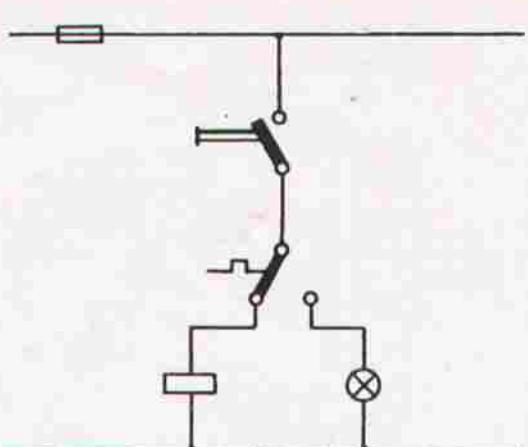


PAK-GERMAN TECHNICAL TRAINING PROGRAMME

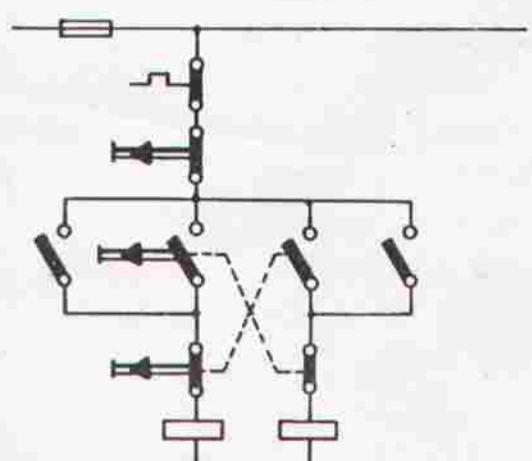
GENERAL



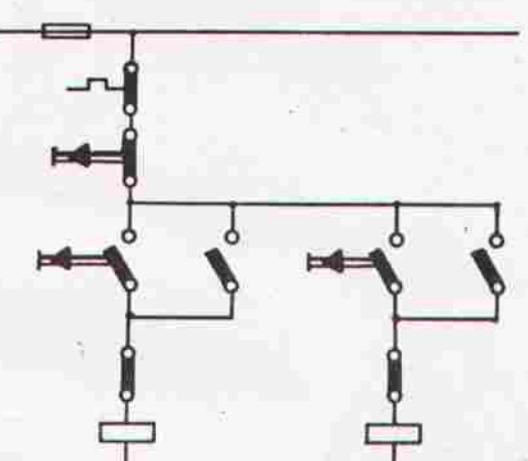
## 1 ON AND OFF CIRCUIT



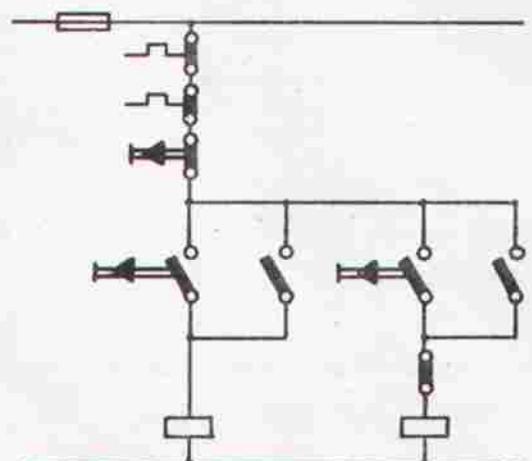
## 2 OVER CURRENT PROTECTION



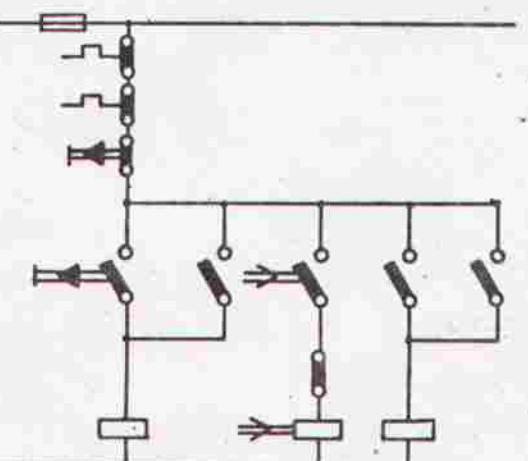
### 3 INTERLOCKING BY SWITCHES



#### INTERLOCKING BY CONTACTORS



## 5 SEQUENCE CONTROL HAND DRIVEN



## 6 SEQUENCE CONTROL TIME RELAY DRIVEN

## Layout

EP 1.1 / 2.5.3 /

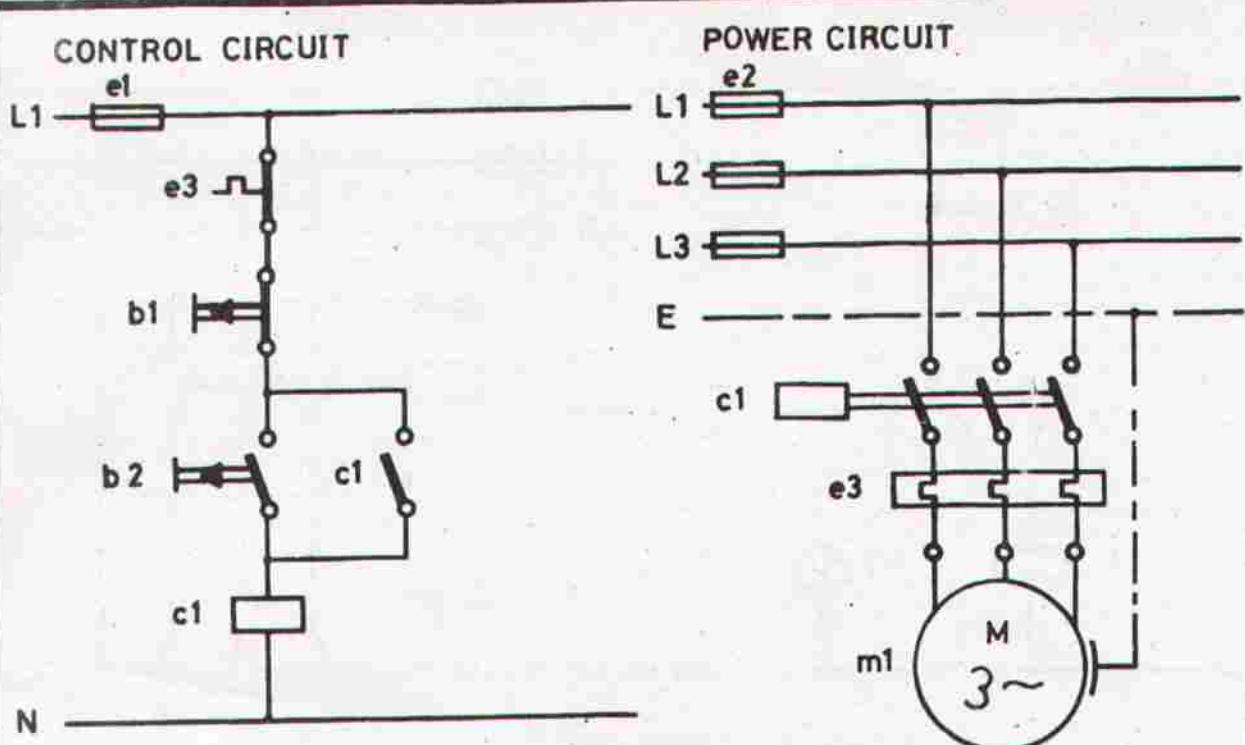
## Circuits



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

**ELECTRICIAN  
GENERAL**



Implementation of a control- and power circuit

Implement the control- and power circuit on the switch panel of the exercise table.

Check the circuit thoroughly.

Voltage is to be applied by the instructor.

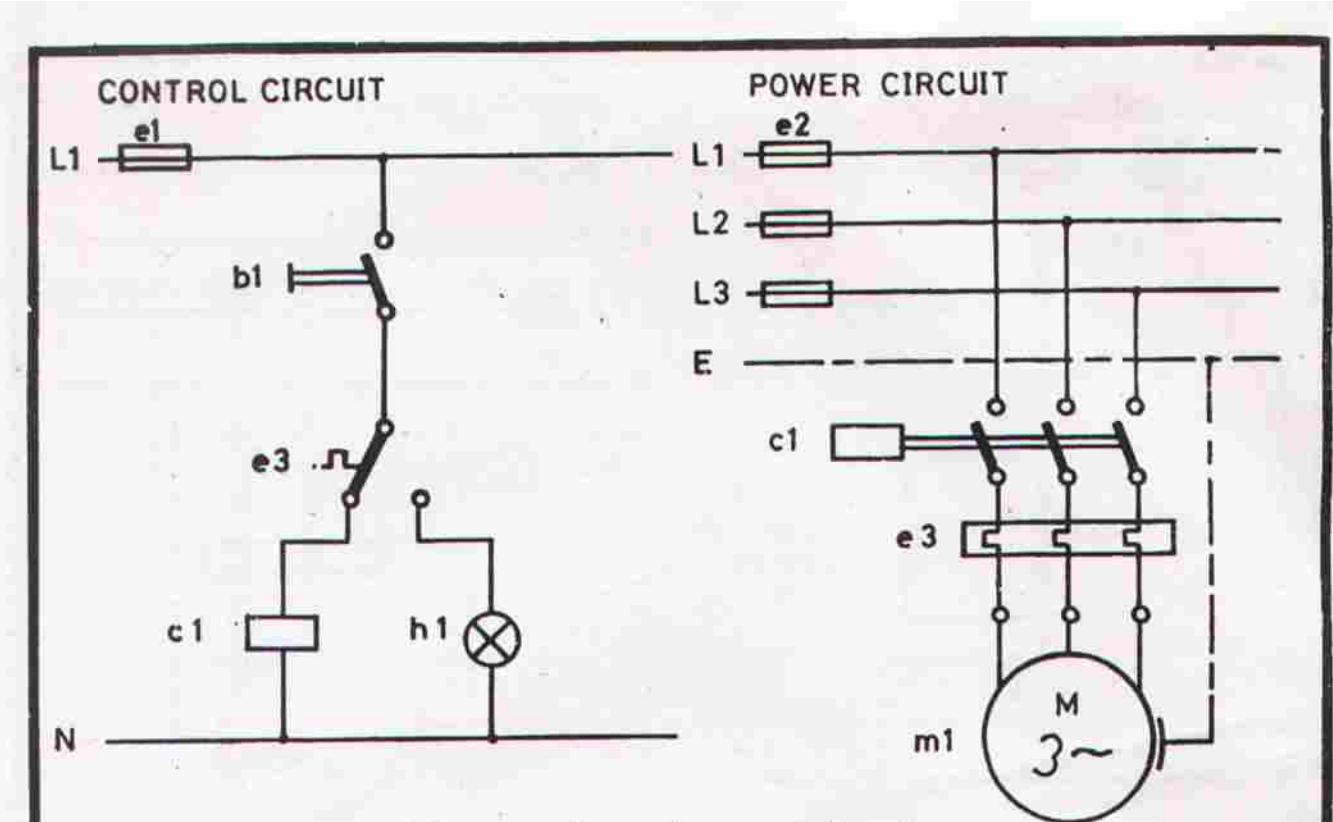
Sequence of testing the functions:

1. Press momentary switch b 2
2. Release momentary switch b 2
3. Press momentary switch b 1
4. Release momentary switch b 1

Describe your observations in brief with your own words.

Note: Auxiliary contact c1, that is no-contact of contactor c1, has to be parallel to the closer contact of momentary switch b2.

	ON-AND OFF CIRCUIT WITH CONTACTOR	EP 1.3/2.5.3/1 Circuits
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL
		27



Implementation of a control- and power circuit

Implement the control- and power circuit on the switch panel of the exercise table.

Check the circuit thoroughly.

Voltage is to be applied by the instructor.

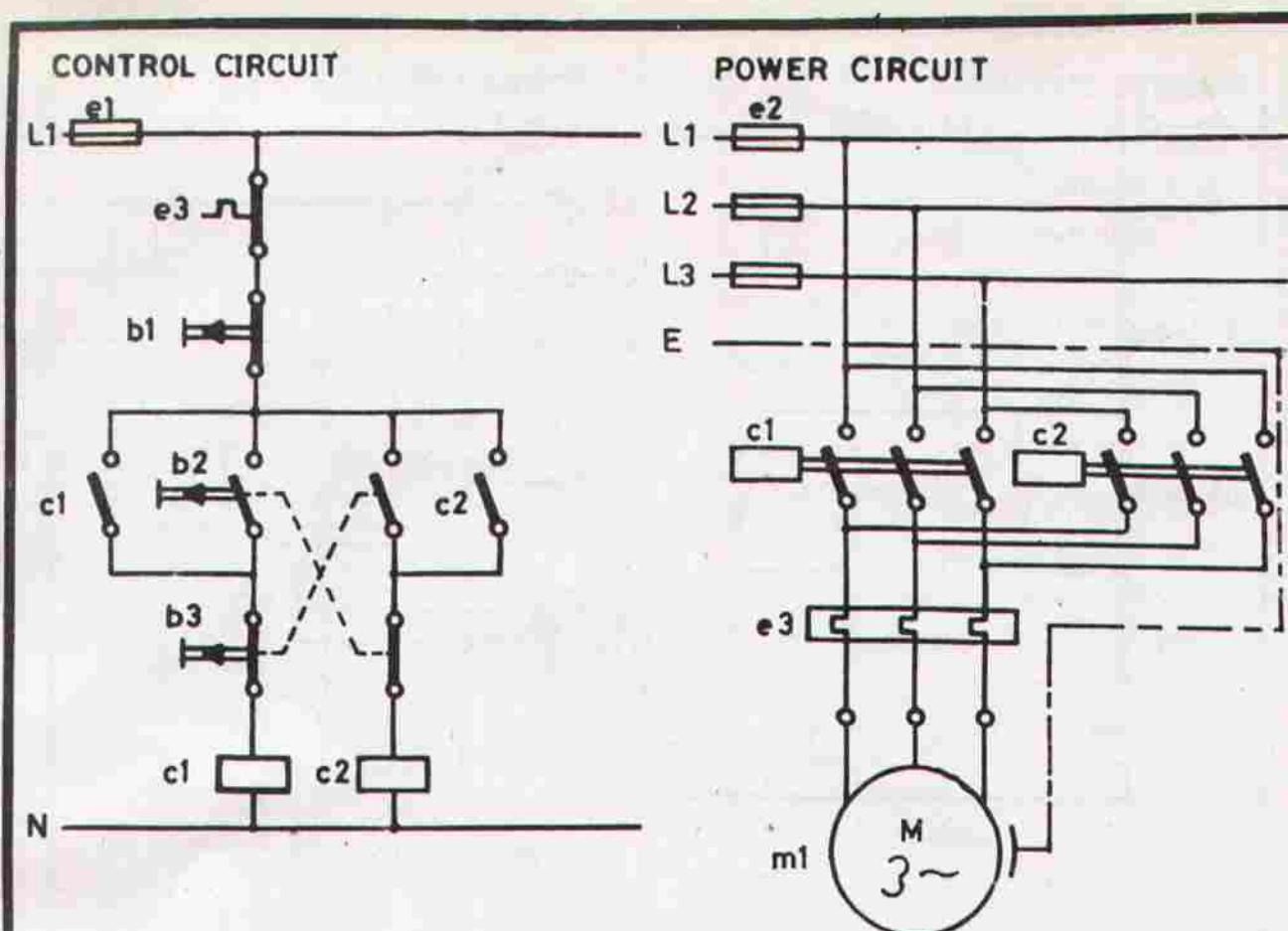
Test the functions as follows:

1. Adjust the electrothermic overcurrent release to the rated current of the motor.
2. Remove one connection to the three phase motor and operate single pole switch b1.
3. Measure the time until the overcurrent release works, that means until control-lamp h1 lights up.
4. Switch off b1.
5. Establish the proper connection to the three phase motor and unlock the thermic overload protection.
6. Switch on b1 and after some time switch off.

Describe your operations in brief.

Note: Contacts of the electro-thermic overload protection have to be in series with the off-switch.

	TESTING THE ELECTRO-THERMIC OVERCURRENT PROTECTION	EP 1.3/2, 5.3/2 Circuits
 DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		ELECTRICIAN GENERAL 28



Implementation of a control- and power circuit

Implement the control- and power circuit on the switch panel of the exercise table.

Check the circuit.

Voltage is to be applied by the instructor.

1. Press momentary switch b2 and release it.
2. Press momentary switch b1 and release it.
3. Press momentary switch b3 and release it.
4. Press momentary switch b1 and release it.
5. Press momentary switch b3 and release it.
6. Press momentary switch b2 and release it.
7. Press momentary switch b1 and release it.
8. Press momentary switches b2 and b3 simultaneously.
9. Switch off by momentary switch b1.

Describe your observations in brief.

Note: Momentary switches with opener and closer contacts connected in opposite branches are used to allow only one contactor at the same time to work.

INTERLOCKING BY SWITCHES

EP 1.3/2.5.3/3

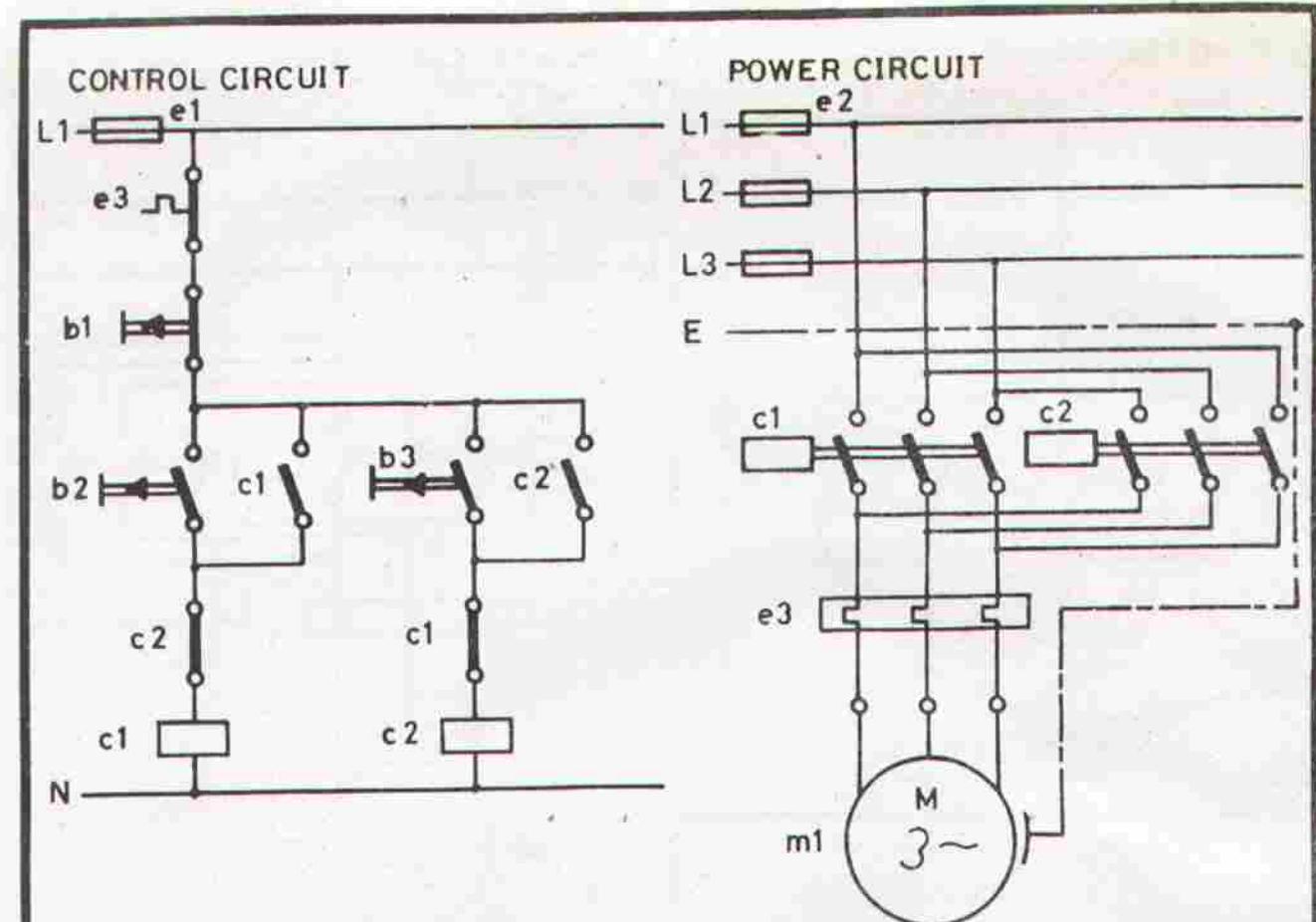
Circuits -



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



### Implementation of a control- and power circuit

Implement the control- and power circuit on the switch panel of the exercise table.

- Check the circuit thoroughly.  
Voltage is to be applied by the instructor.

#### Sequence of testing the functions:

1. Press momentary switch b2 and release it.
2. Press momentary switch b3 and release it.
3. Press momentary switch b1 and release it.
4. Press momentary switch b3 and release it.
5. Press momentary switch b2 and release it.
6. Press momentary switch b1 and release it.
7. Press momentary switch b2 and release it.

Describe your observations in brief.

Note: If it is demanded that only one contactor can work at the moment then there has to be a nc-auxiliary-contact in series with each opposite contactor.

A combination of both interlocking systems (exercises 4 and 5) will increase the function.

## INTERLOCKING BY CONTACTORS

EP 13/253/4

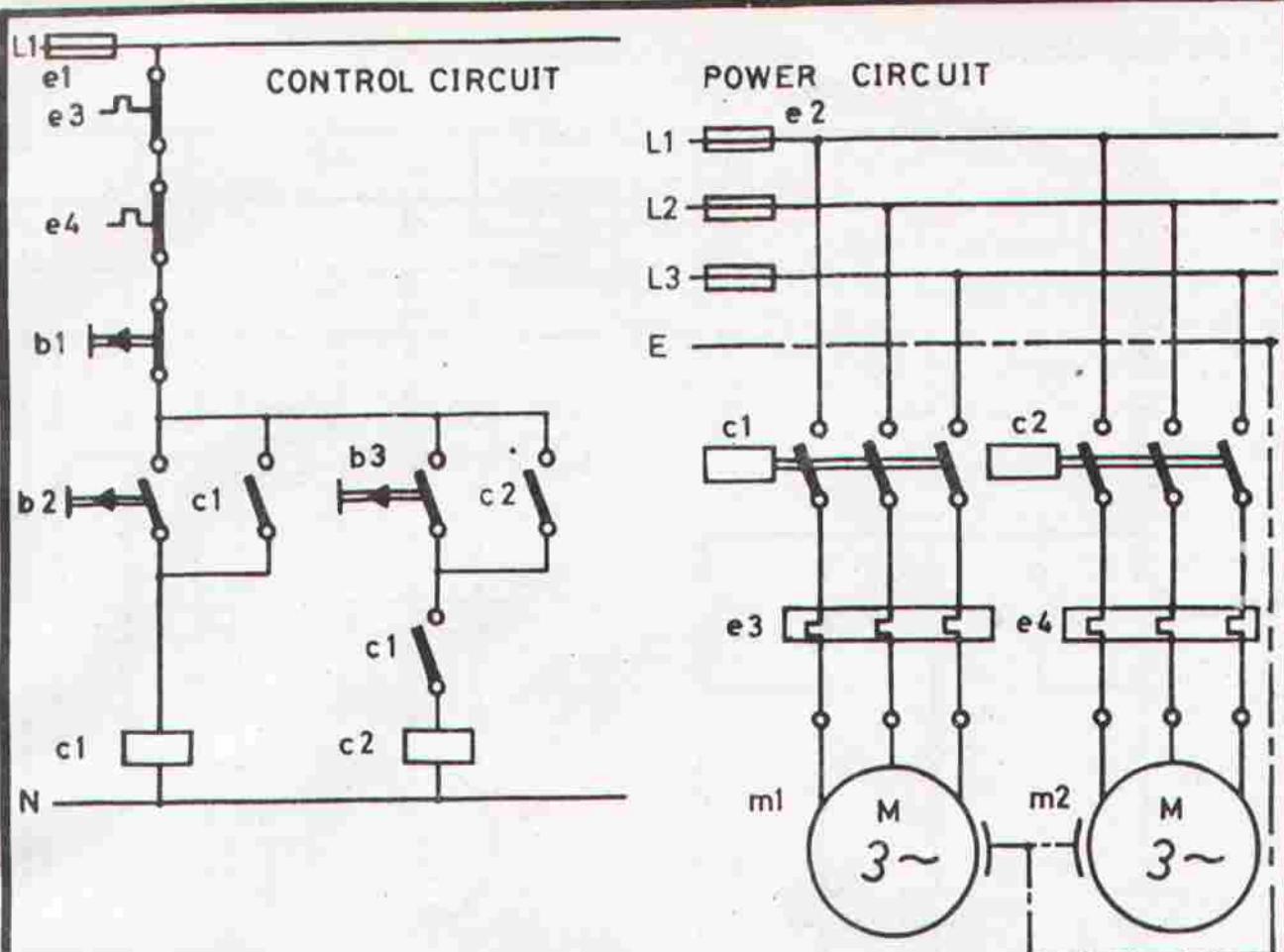
## Circuits



## DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

## ELECTRICIAN GENERAL



Implementation of a control- and power circuit

Implement the control- and power diagram on the switch panel of the exercise table.

Check the circuit thoroughly.

Voltage is to be applied by the instructor.

Sequence of testing the functions:

1. Press momentary switch b3 and release it.
2. Press momentary switch b2 and release it.
3. Press momentary switch b3 and release it.
4. Press momentary switch b1 and release it.

Describe your observations in brief.

Note: A no-auxiliary-contact of contactor c1 before contactor c2 means that contactor c2 only can be driven after contactor c1 has been operated.

SEQUENCE CONTROL HAND DRIVEN

EP 1.3/2.5.3/5

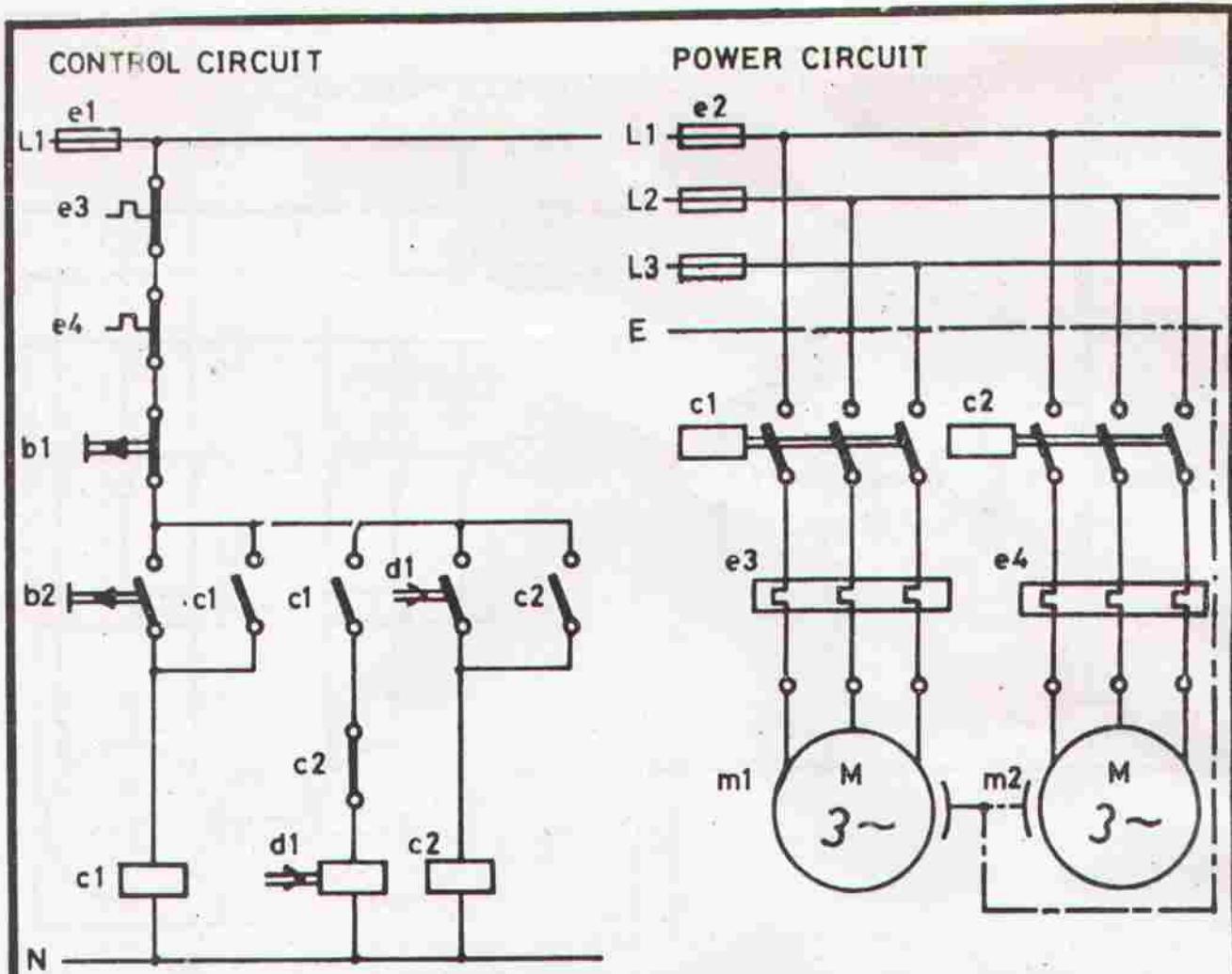
Circuits

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

ELECTRICIAN  
GENERAL



PAK-GERMAN TECHNICAL TRAINING PROGRAMME



Implementation of a control- and power circuit

Implement the control- and power circuit on the switch panel.

Check the circuit.

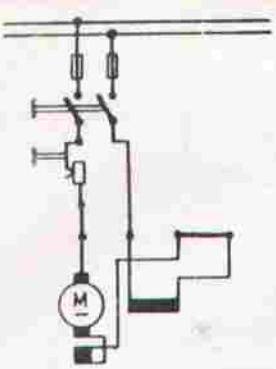
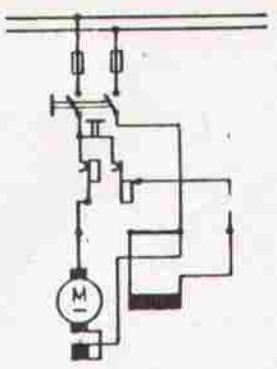
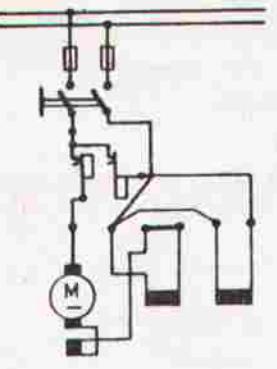
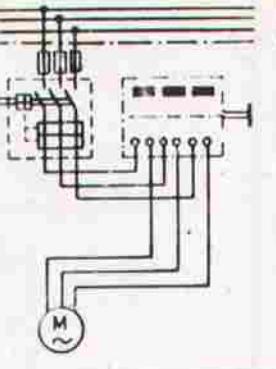
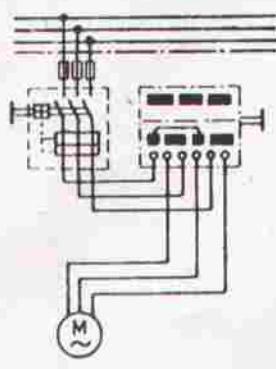
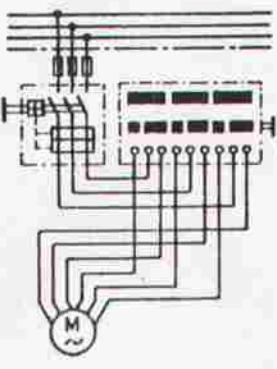
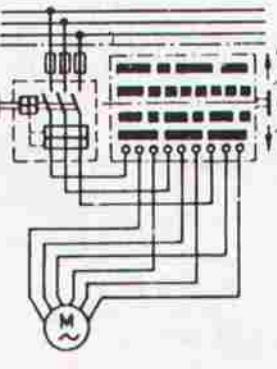
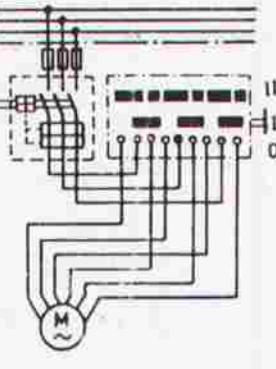
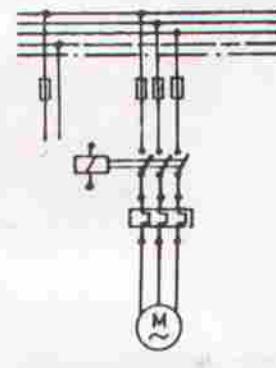
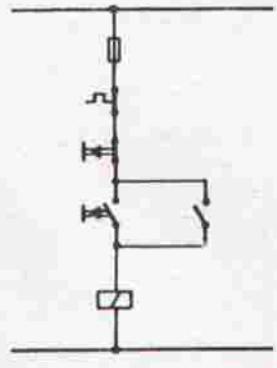
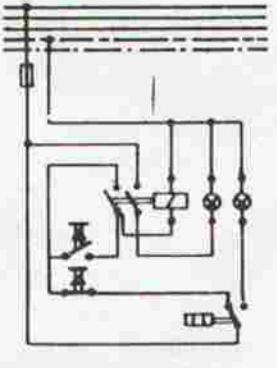
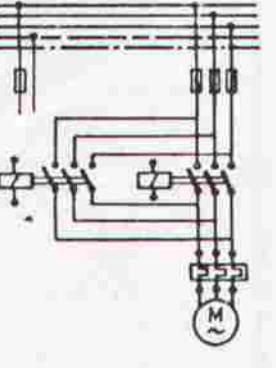
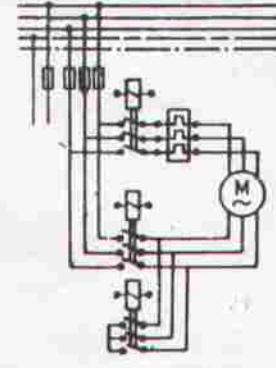
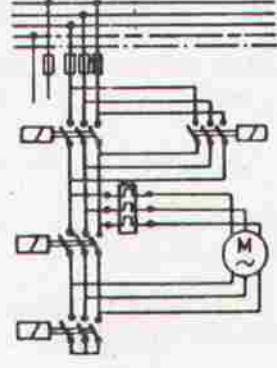
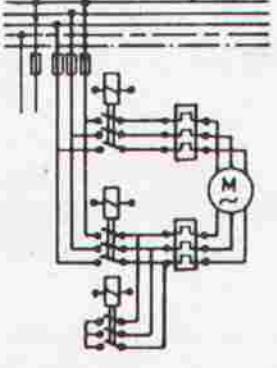
Voltage is to be applied by the instructor.

Sequence of testing the functions:

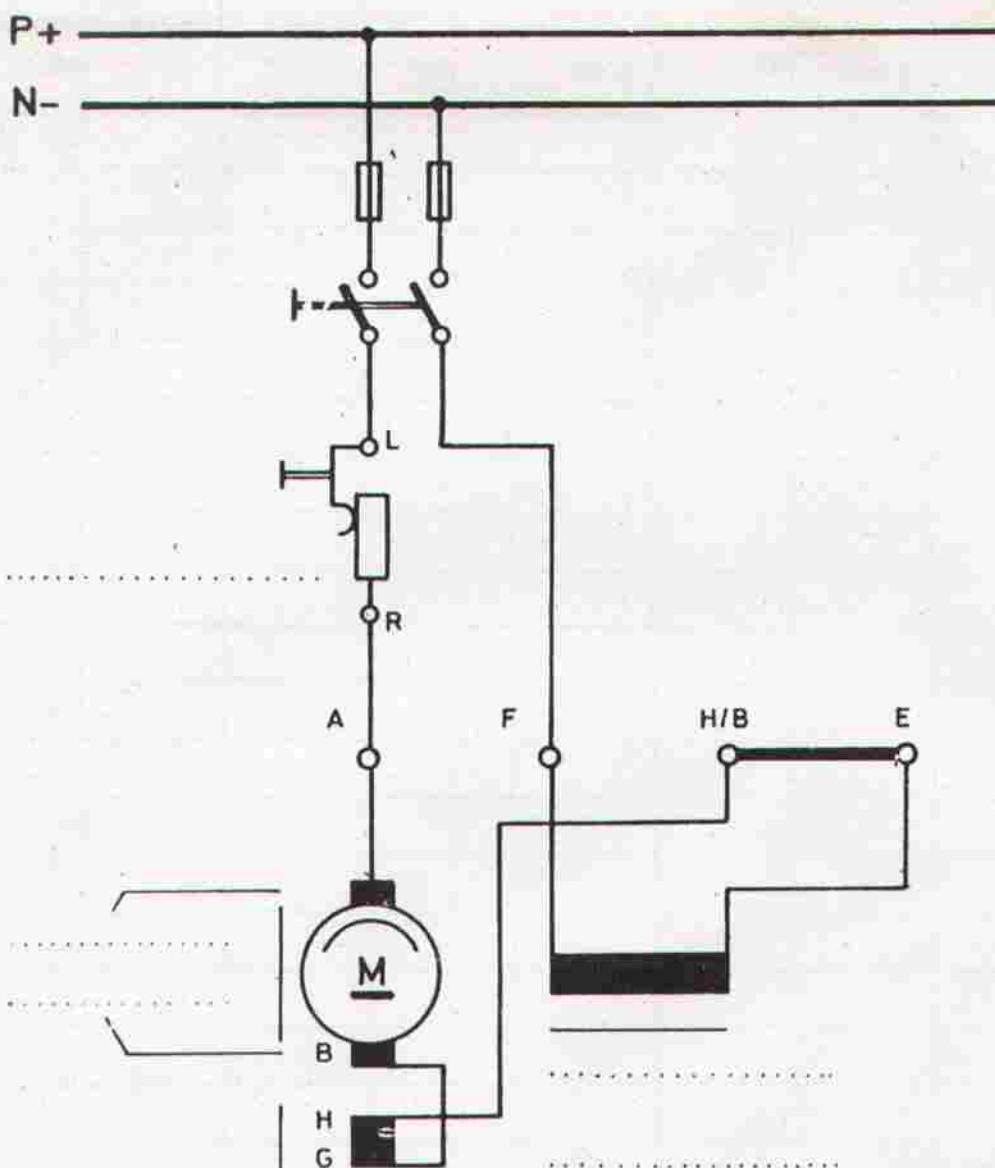
1. Press momentary switch b2 and release it.
2. Observe the sequence of starting of the motors.
3. Press momentary switch b1 and release it.
4. Adjust another time of the time relay and start again with momentary switch b2.

Note: This given circuit is similar to the circuit of exercise 5, but it is working automatically due to auxiliary contactor d1.

	SEQUENCE CONTROL TIME RELAY DRIVEN	EP 13/2.5.3/6
		Circuits
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING	ELECTRICIAN GENERAL
	PAK-GERMAN TECHNICAL TRAINING PROGRAMME	32

			
1 DC - SERIES MOTOR	2 DC - SHUNT MOTOR	3 DC - COMPOUND MOTOR	4 SWITCH, ON-OFF
			
5 SWITCH, REVERSING	6 SWITCH, $\lambda\Delta$	7 SWITCH, $\lambda\Delta$ REVERSING	8 SWITCH, MULTI SPEED
			
9 CONTACTOR ON-OFF	10 CONTACTOR ON-OFF	11 CONTACTOR ON-OFF	12-13-14 CONTACTOR REV- FOR POWER CIRCUITS 12, 15, 18, 21, THERE ARE SEPARATE CURRENT PATH AND WIRING DIAGRAMS (13-14, 16-17, 19-20, 22-23.) ALL EXERCISE SHEETS MAY BE USED FOR IN- STALLATION AS WELL AS FOR PLUG WIRING EXERCISES.
			
15-16-17 CONTACTOR $\lambda\Delta$	18-19-20 CONTACTOR $\lambda\Delta$ REV	21-22-23 CONT-MULTI SPEED	
	LAYOUT		EP 1.1 / 3.5.1/ Motors & Switches, Contactors, Circuits
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		ELECTRICIAN GENERAL
			33





### CLOCKWISE

A F H/B E  
O O O O

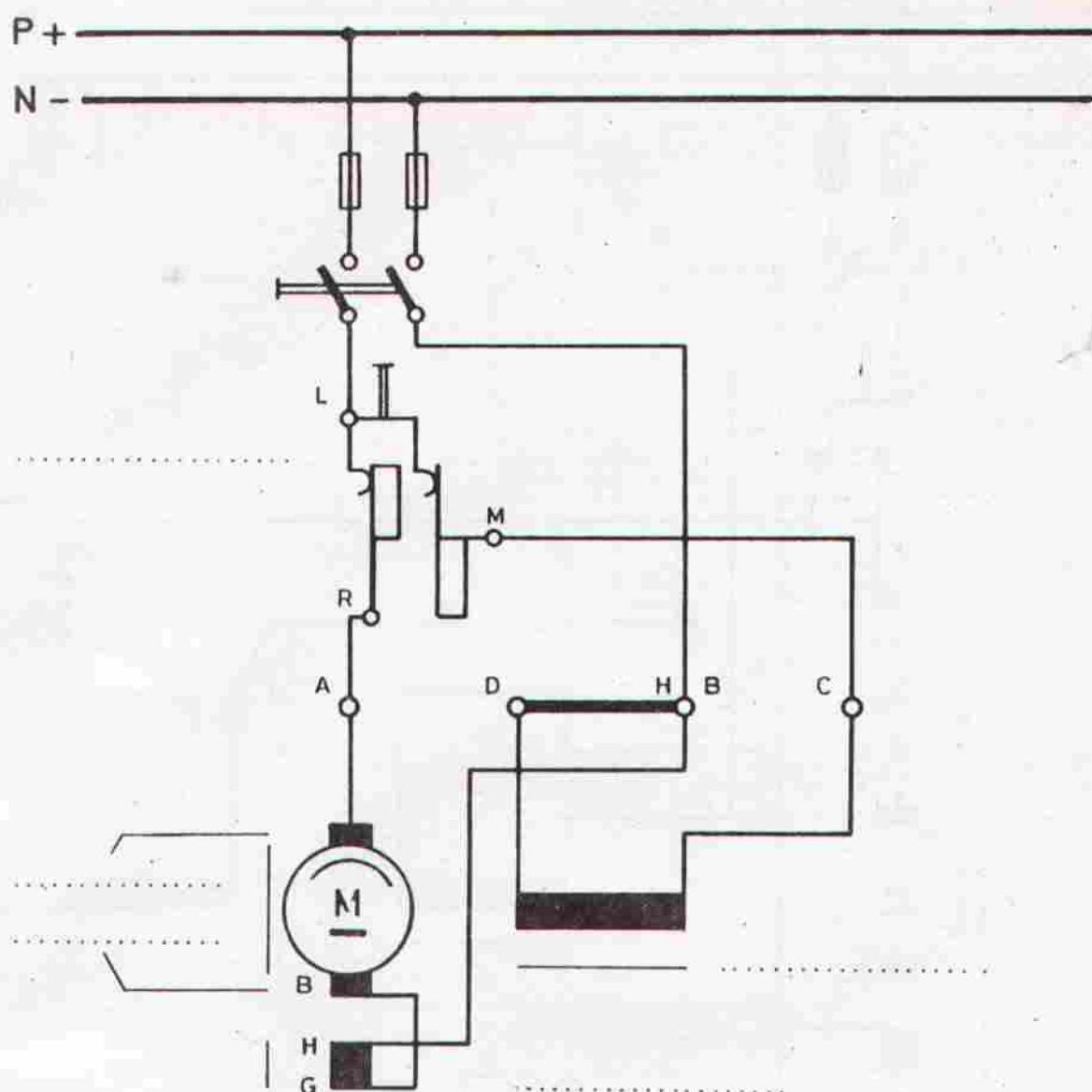
DRAW CONNECTIONS AND  
LINKS FOR CLOCKWISE AND  
ANTI-CLOCKWISE DRIVE

### ANTI-CLOCKWISE

A F H/B E  
O O O O

- a.) MARK FLOW OF CURRENT AND DIRECTION OF MOTOR ROTATION (arrow head)
- b.) GIVE NAME OF COMPONENTS ON DOTTED LINES
- c.) WHAT MEASURES CAN BE TAKEN TO INCREASE OR DECREASE THE SPEED/POWER
- d.) TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.
- e.) WHAT RULES CAN YOU APPLY TO DETERMINE THE FLOW (Direction) OF CURRENT?

	SERIES WOUND D.C MOTOR	EP 1.3/3.5.W1 Motors & Switches
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 36



CLOCKWISE

A	D	H/B	C
○	○	○	○

DRAW CONNECTIONS AND  
LINKS FOR CLOCKWISE AND  
ANTI-CLOCKWISE DRIVE

ANTI-CLOCKWISE

A	D	H/B	C
○	○	○	○

- MARK FLOW OF CURRENT AND DIRECTION OF MOTOR ROTATION (arrow head).
- GIVE NAME OF COMPONENTS ON DOTTED LINES.
- WHAT MEASURES CAN BE TAKEN TO INCREASE OR DECREASE THE SPEED/POWER.
- TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.
- WHAT RULES CAN YOU APPLY TO DETERMINE THE FLOW (Direction) OF CURRENT?

SHUNT WOUND D.C. MOTOR

EP 1.3/3.5.1/2

Motors & Switches

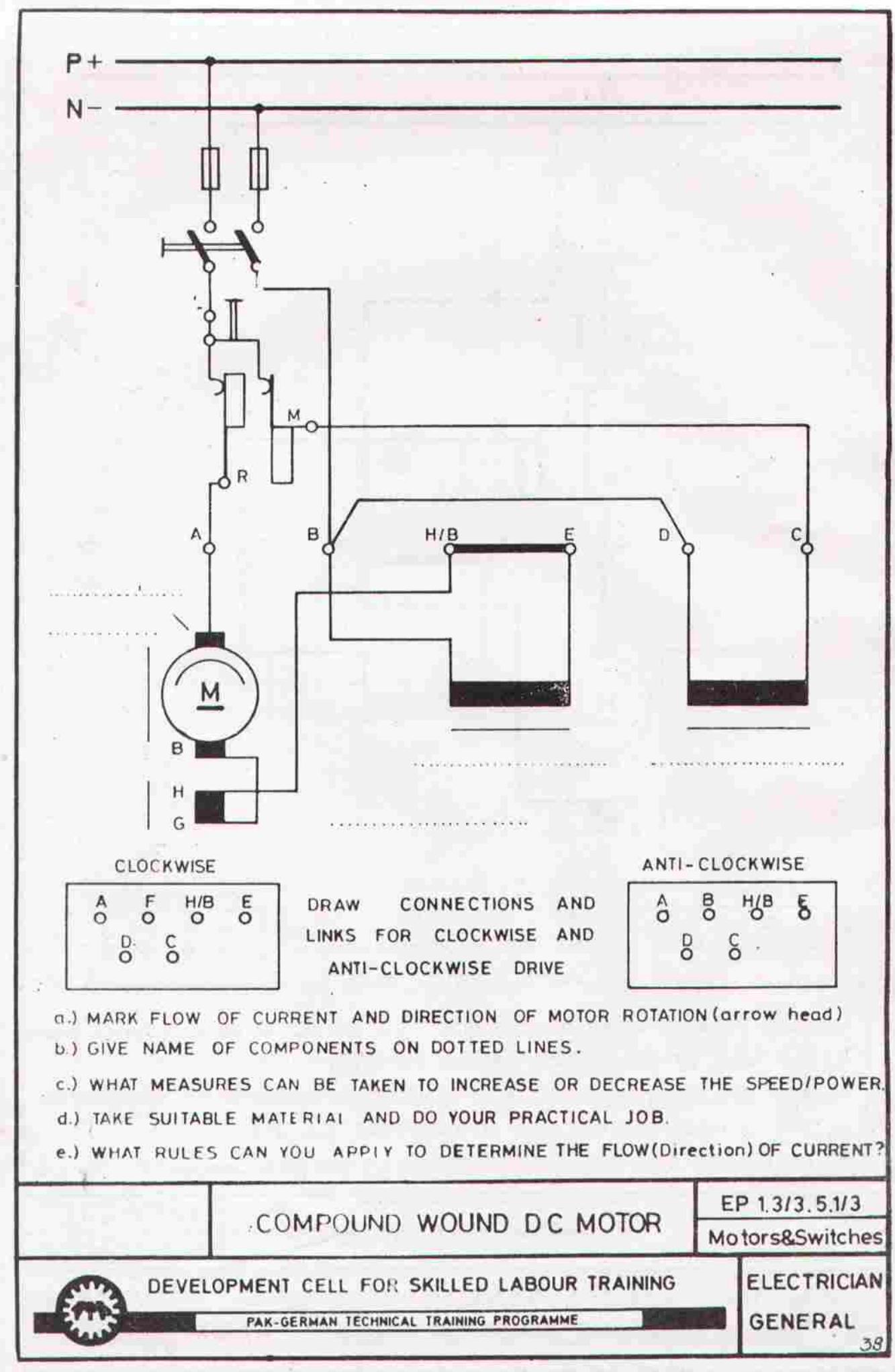


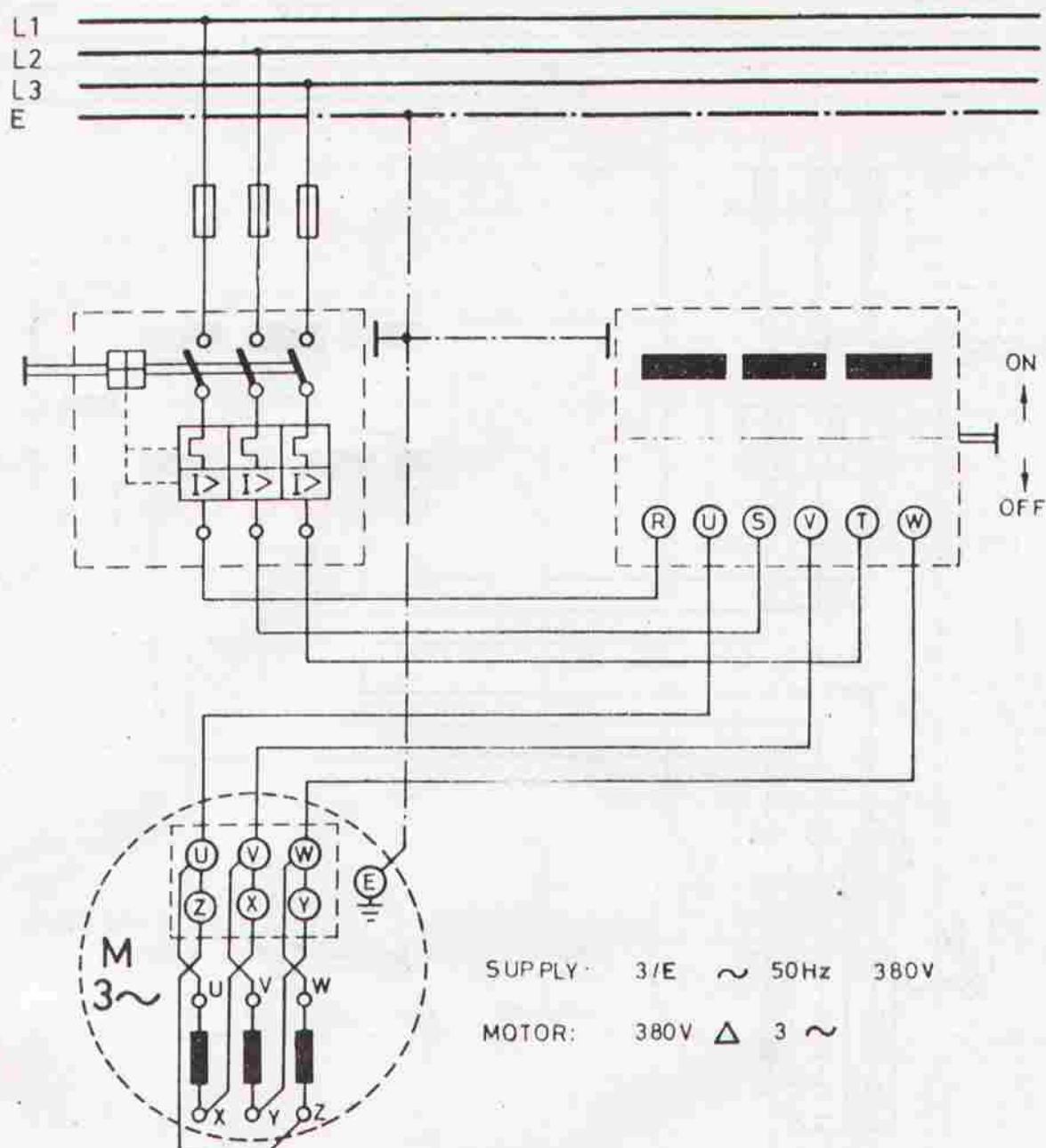
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

37



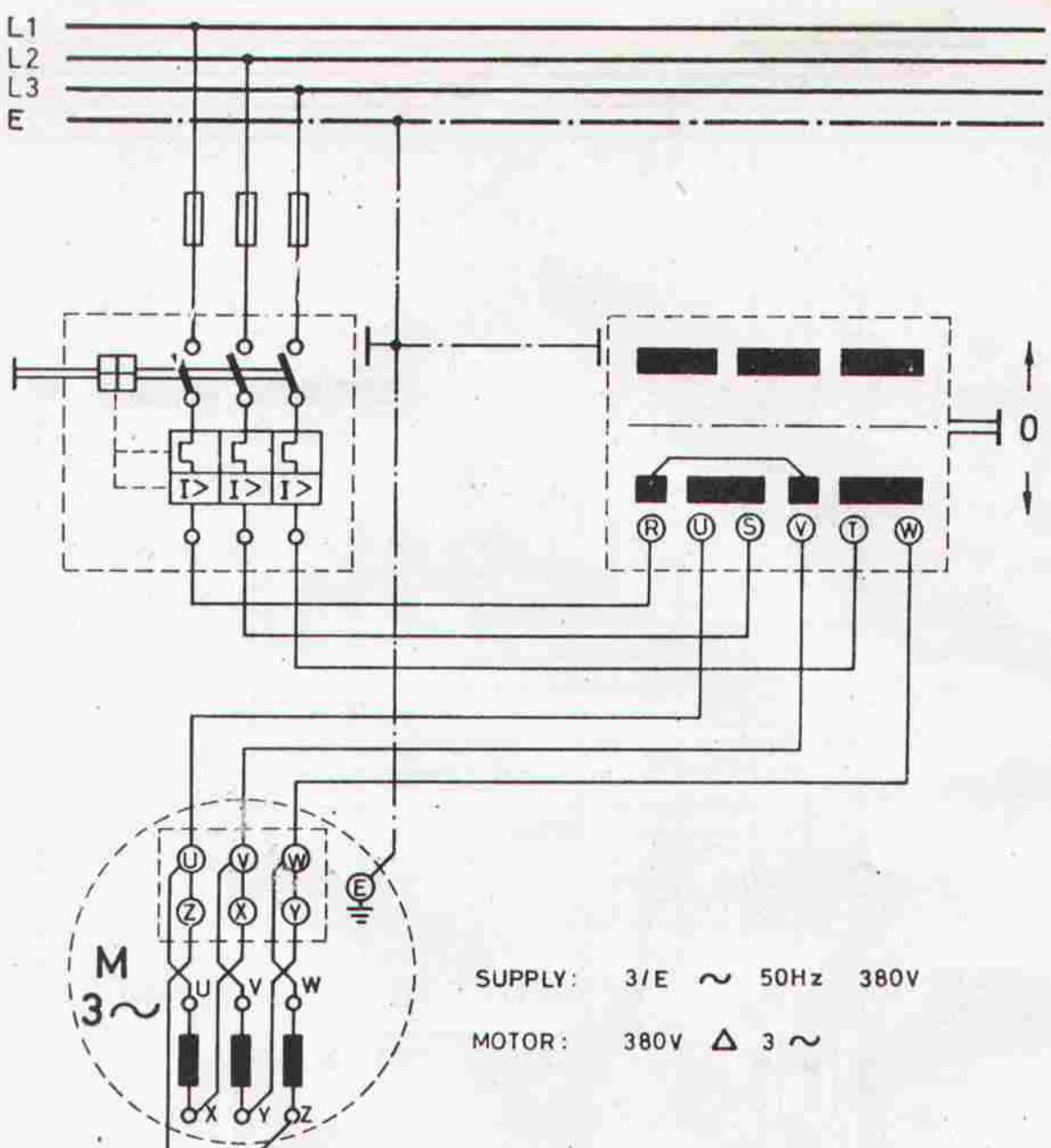


TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.

ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD  
INSTALLATION EXERCISE.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

	ON-OFF DRUM SWITCH	EP 1.3/3.5.1/4 Motors & Switches
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL



TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.

ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD  
INSTALLATION EXERCISE.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

REVERSING DRUM SWITCH

EP 1.3/3.5.1/5

Motors & Switches

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

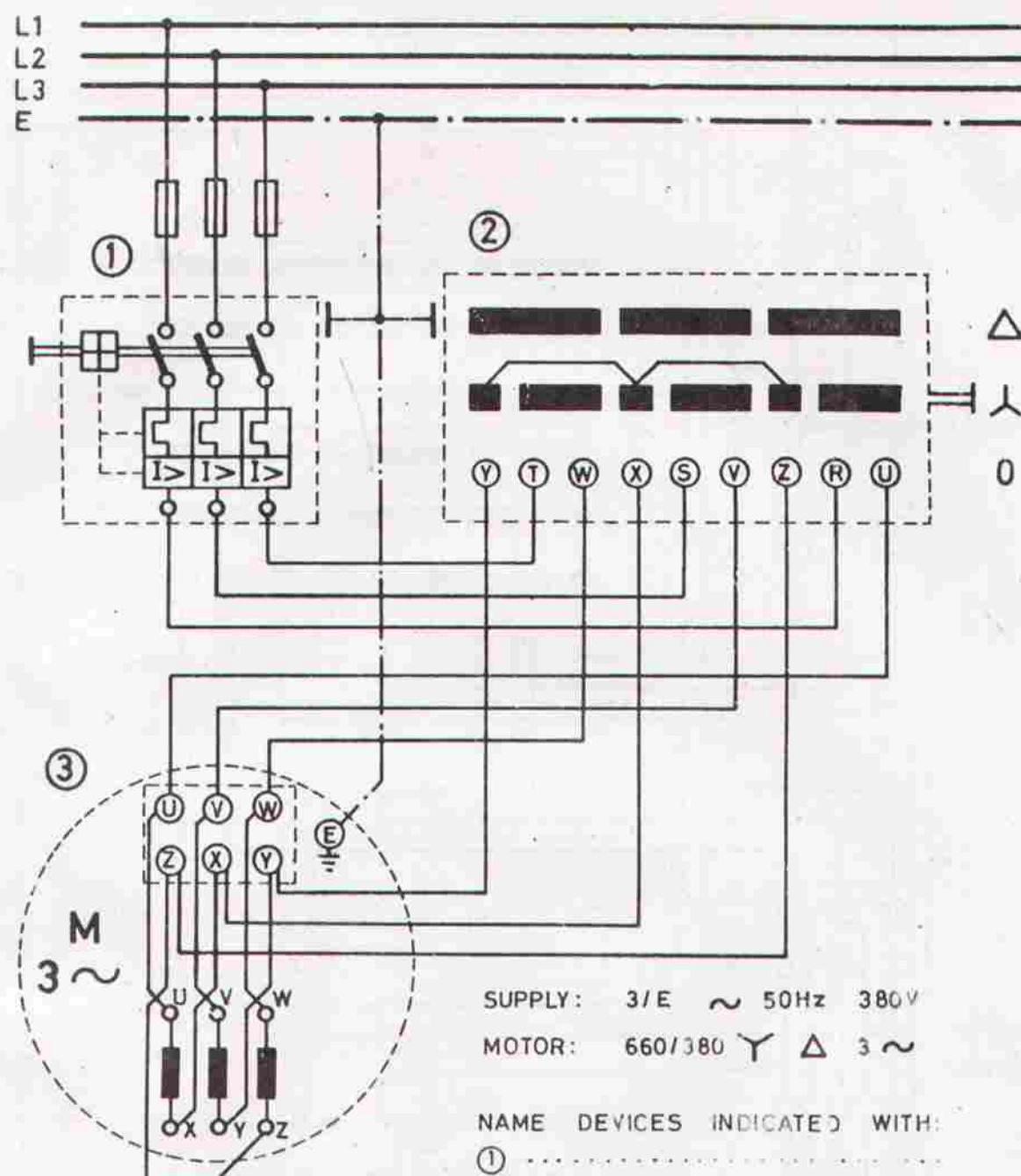
ELECTRICIAN

GENERAL



PAK-GERMAN TECHNICAL TRAINING PROGRAMME

40



TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL

ACCORDING TO INSTRUCTORS DECISION  
INSTALLATION EXERCISE.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR OR

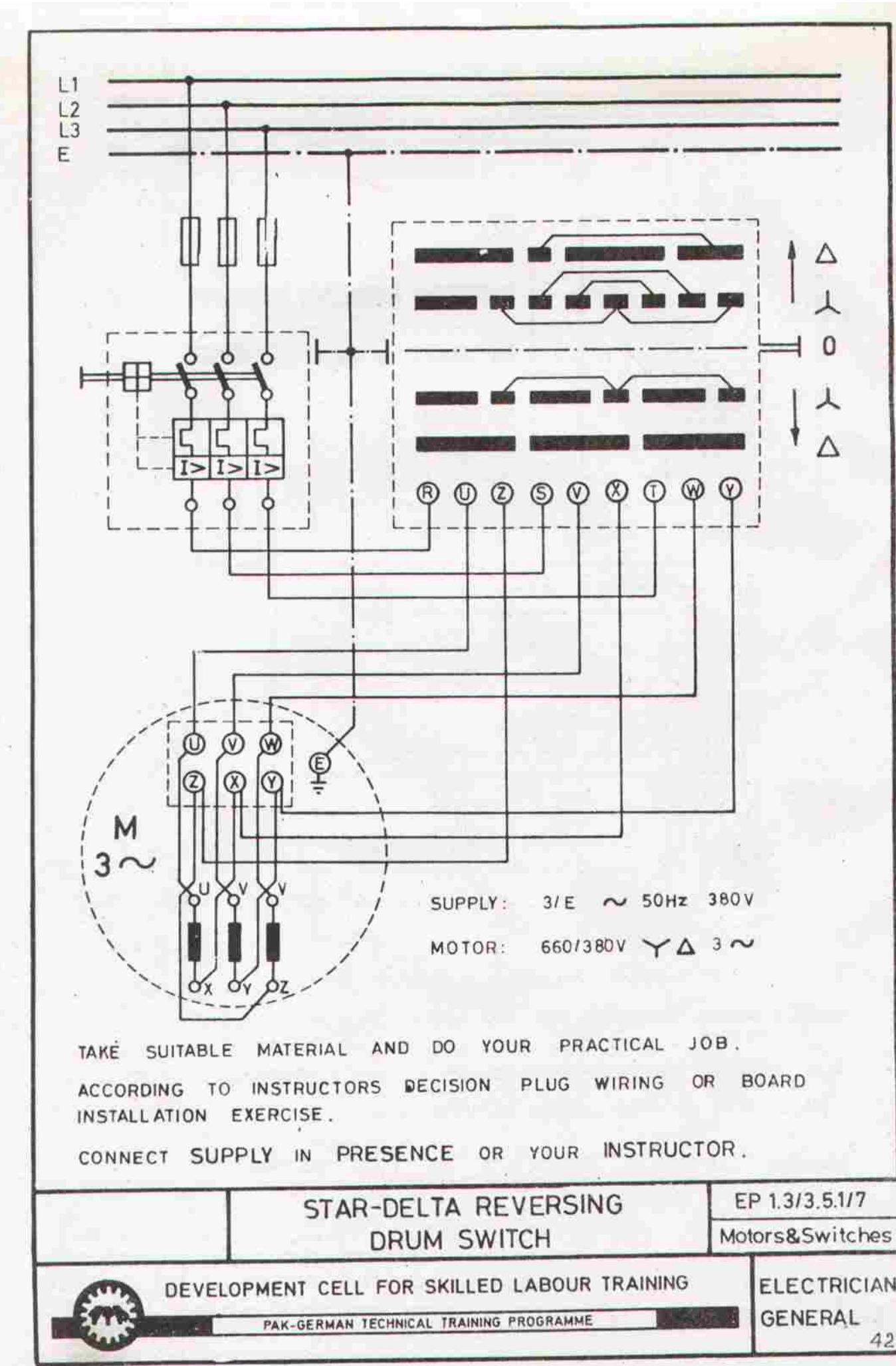
STAR-DELTA DRUM SWITCH

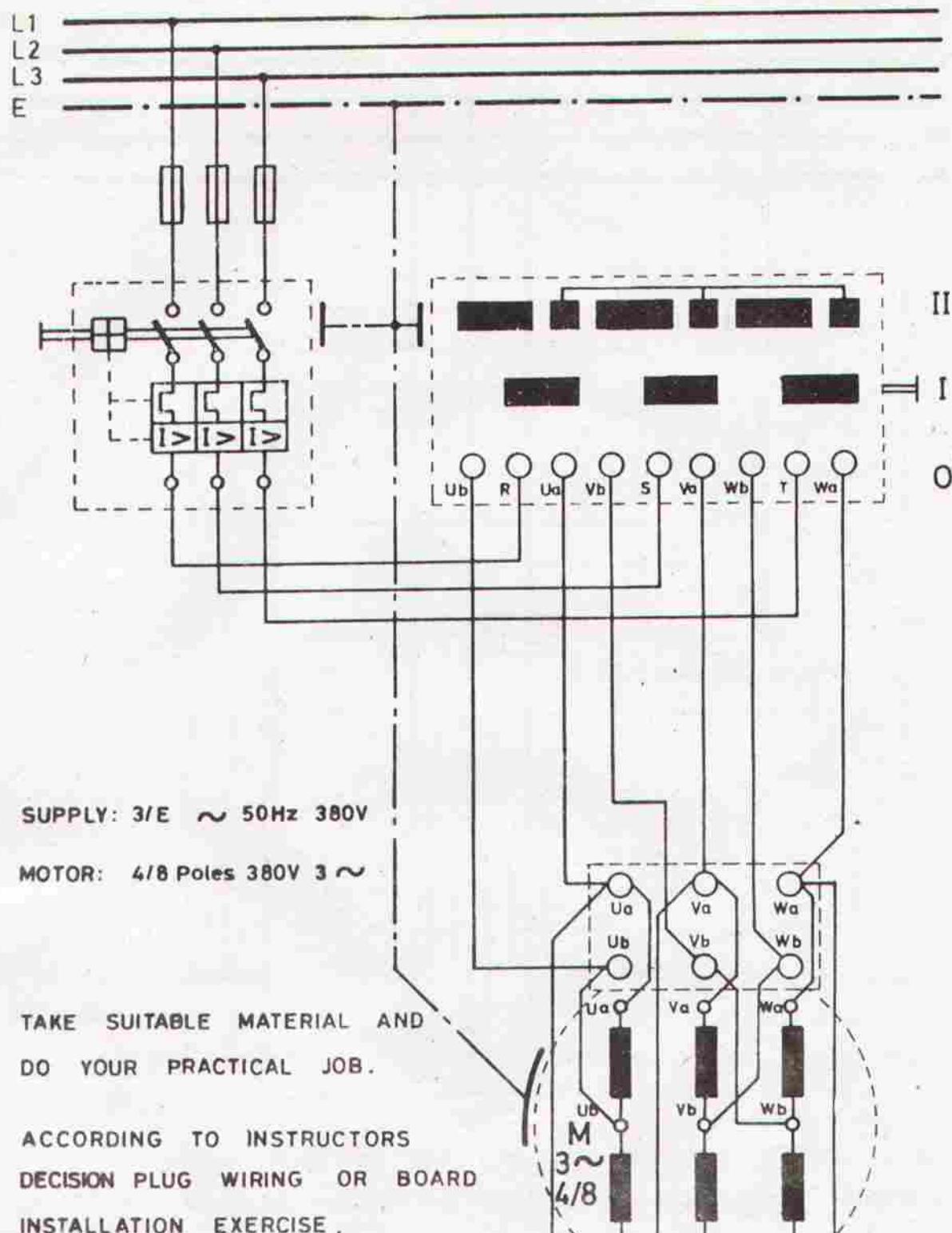
EP 1.3/3.5.1/6  
Motors & Switches

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL





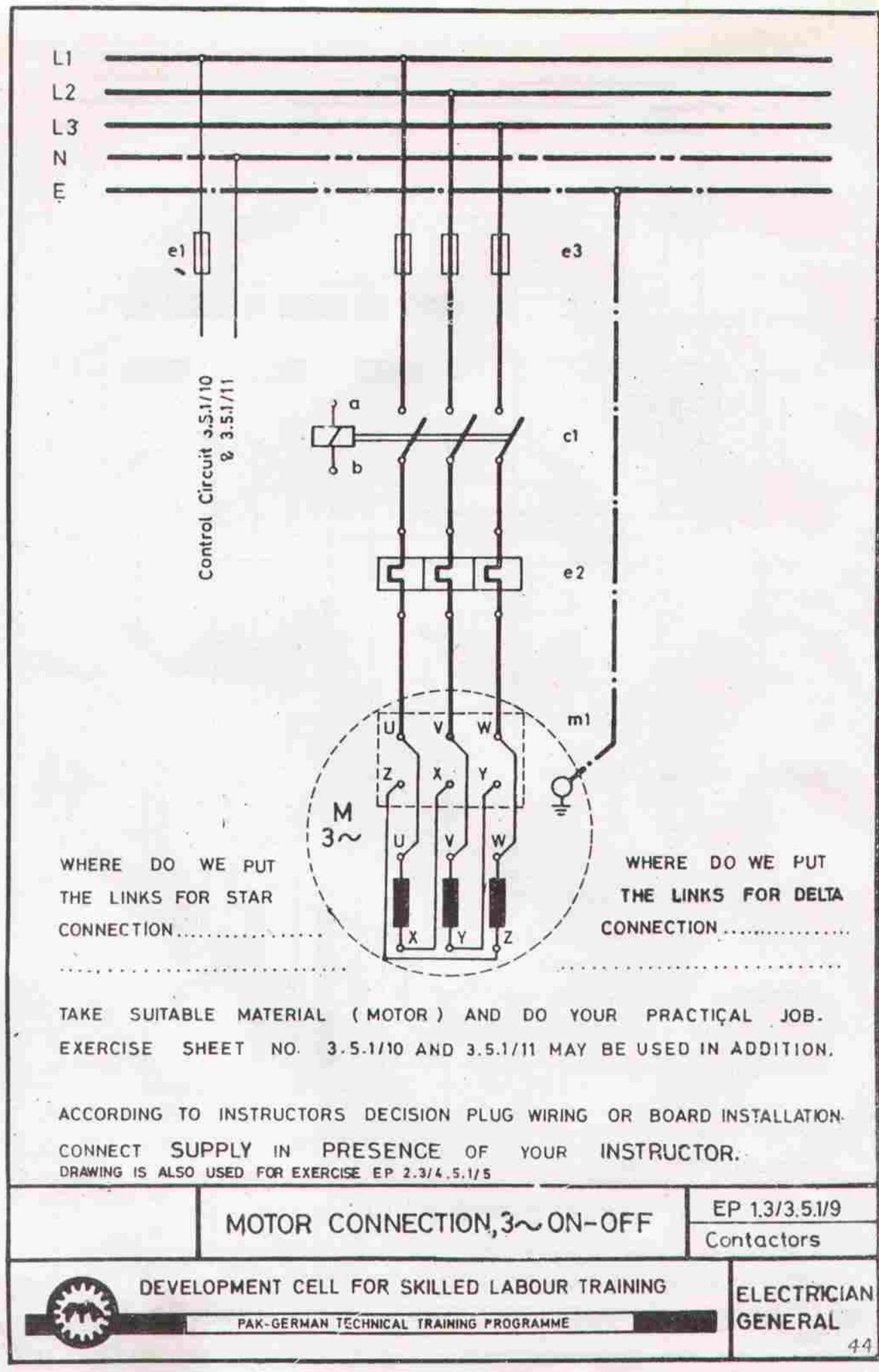
MULTI SPEED DRUM SWITCH

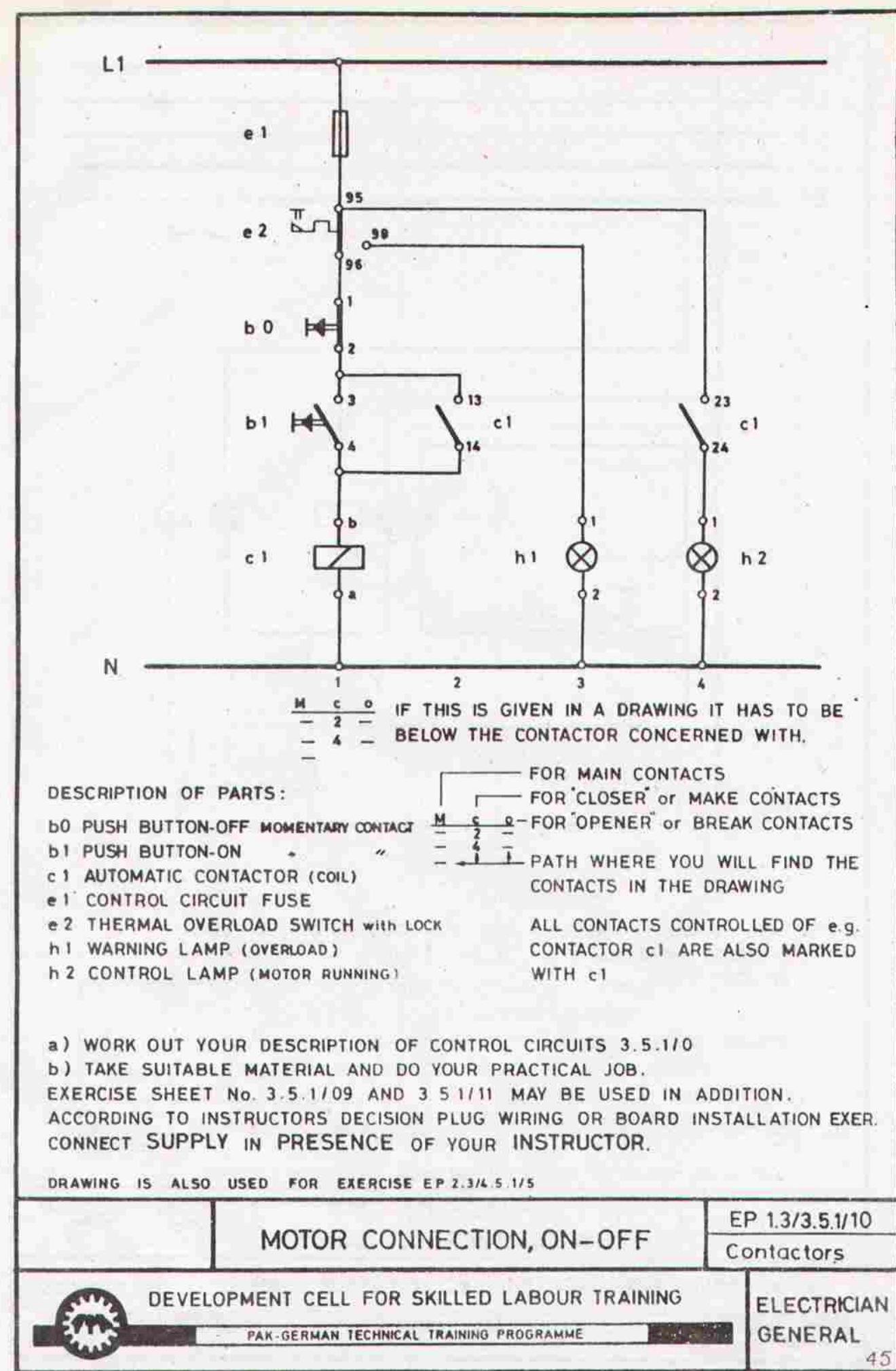
EP 1.3/3.5.1/8  
Motors&Switches

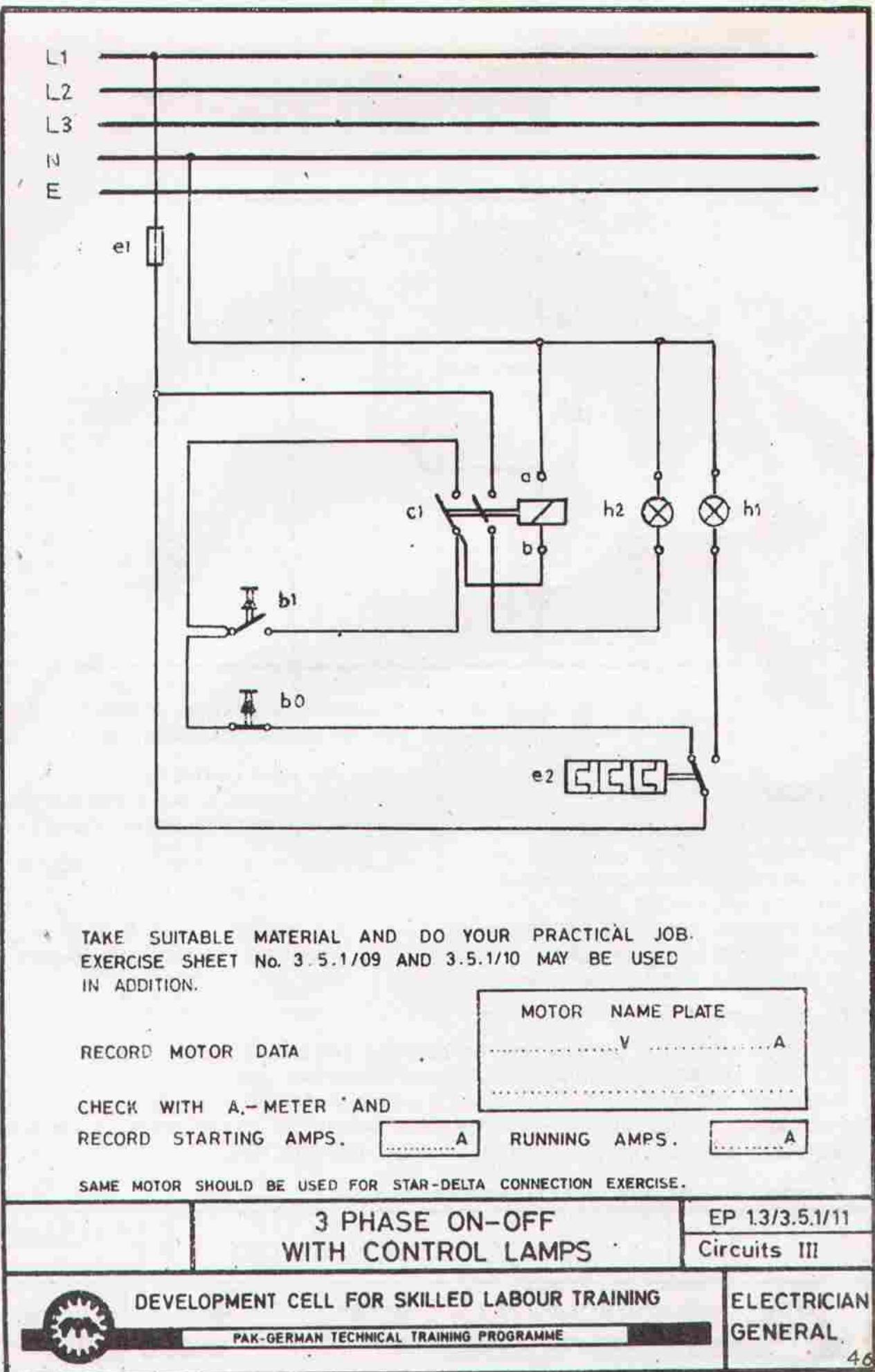
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

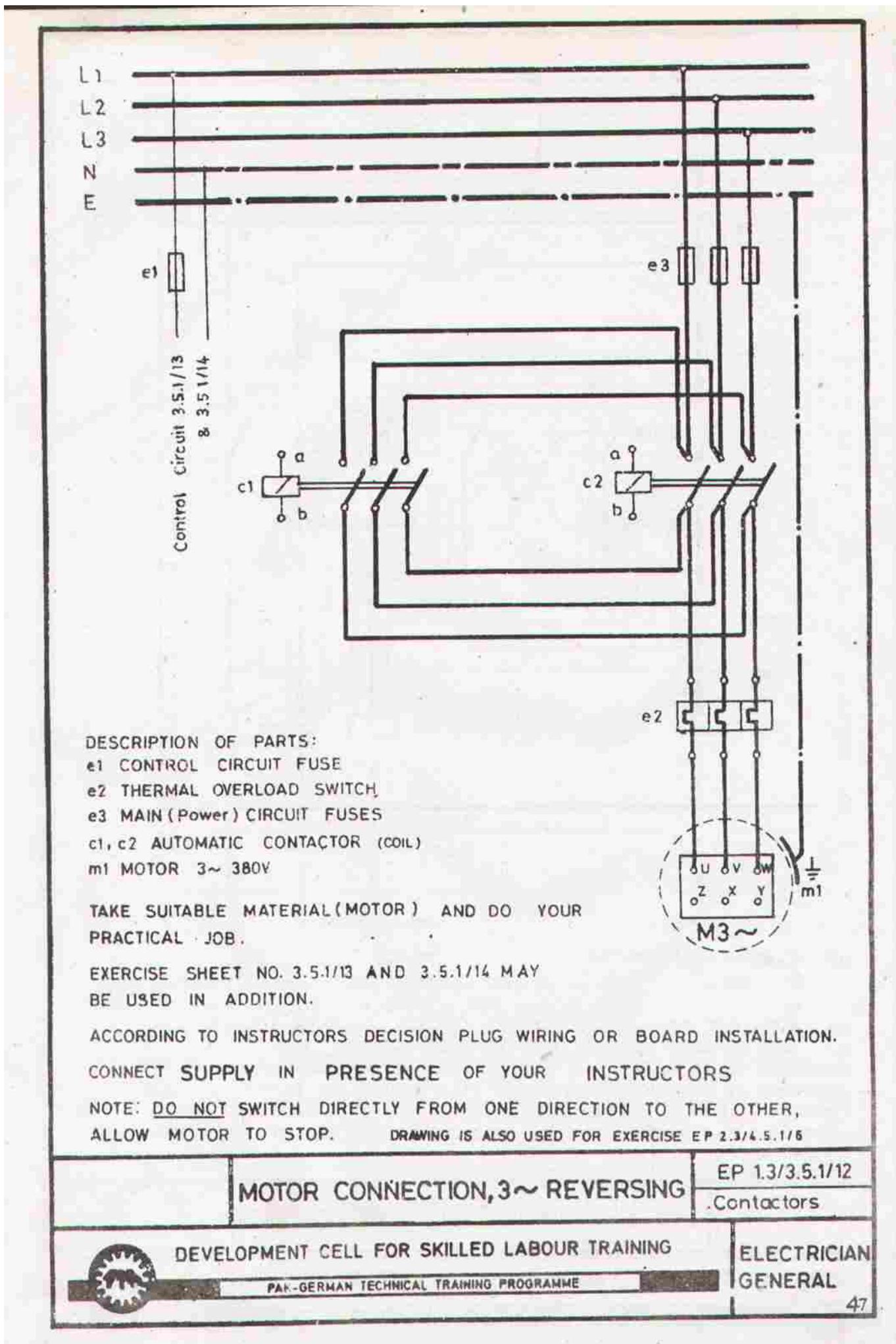
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

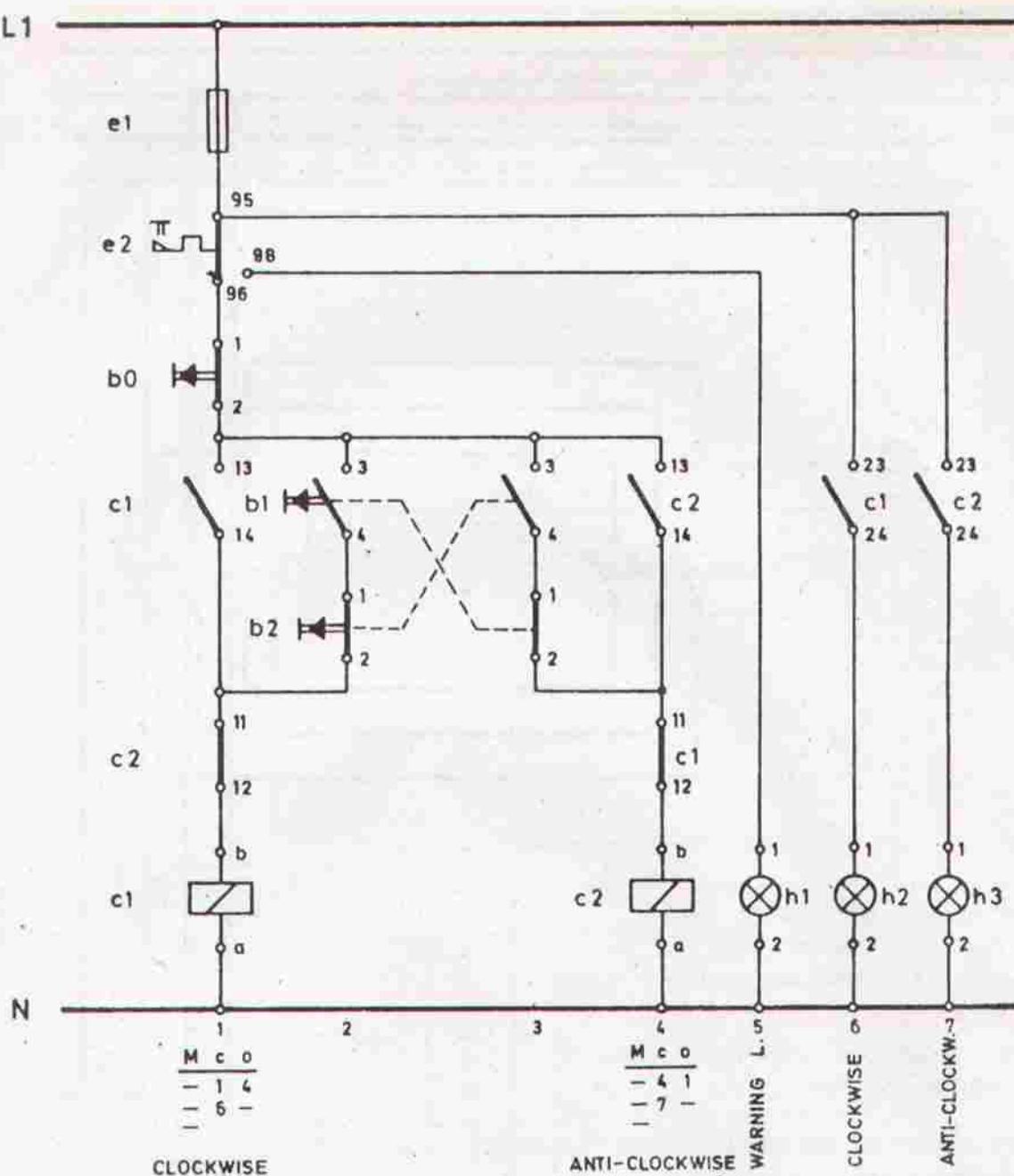
ELECTRICIAN  
GENERAL











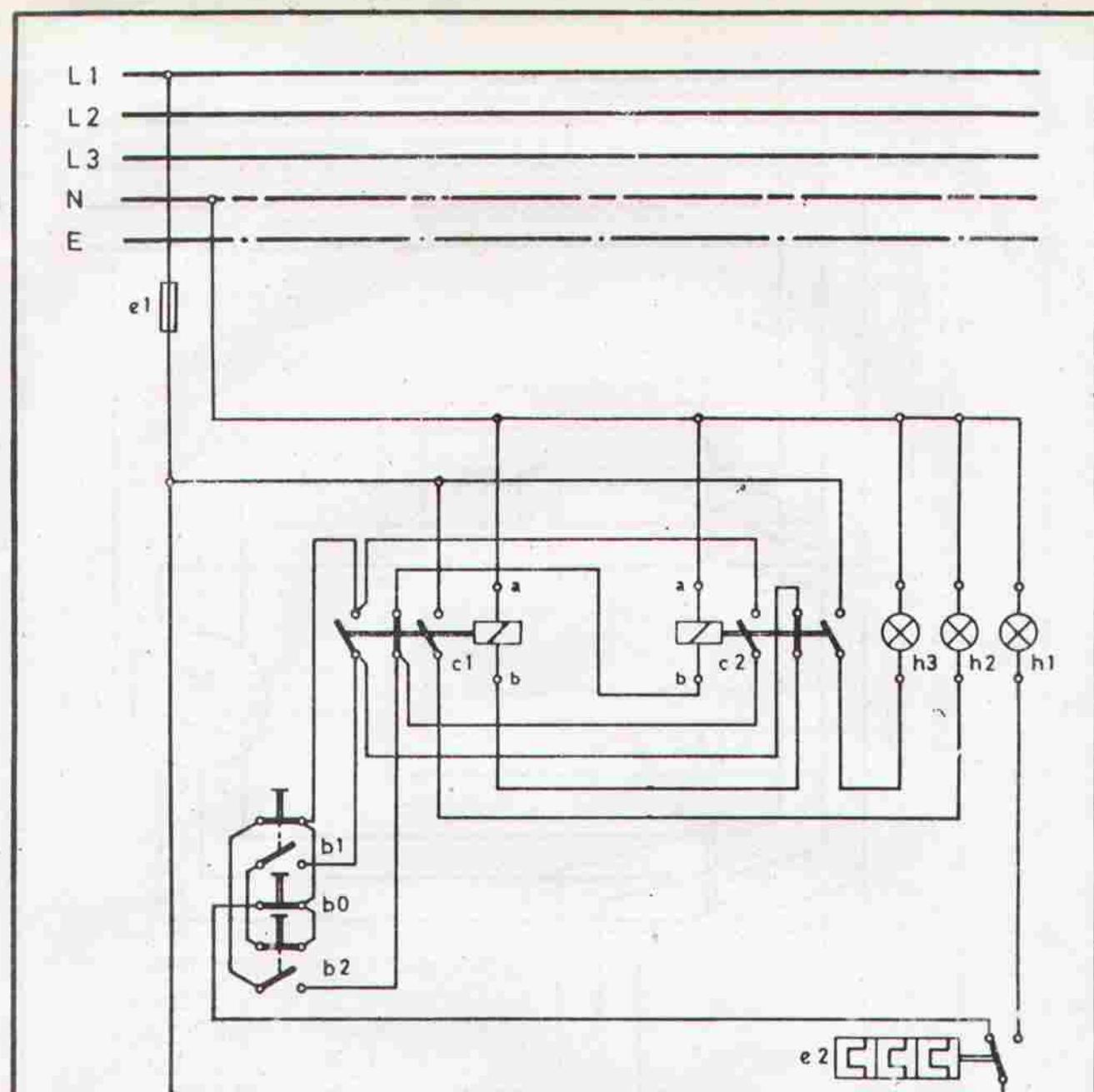
a.) GIVE DESCRIPTION OF: c1, c2, ..., c6  
 e1, ..., e6  
 e2, ..., e6

b.) WORK OUT YOUR DESCRIPTION OF CONTROL CIRCUITS 3.5.1/0

c.) TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.

EXERCISE SHEET NO. 3.5.1/12 AND 3.5.1/14 MAY BE USED IN ADDITION.  
 ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.  
 CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.  
 NOTE: DO NOT SWITCH DIRECTLY FROM ONE DIRECTION TO THE OTHER,  
 ALLOW MOTOR TO STOP  
 DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4.5.1/6

DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4.5.1/6	EP 1.3/3.5.1/13
<b>MOTOR CONNECTION 3~ REVERSING</b>	Contactors
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING	ELECTRICIAN GENERAL
PAK-GERMAN TECHNICAL TRAINING PROGRAMME	48



TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.

EXERCISE SHEET No. 3.5.1/12 AND 3.5.1/13 MAY BE USED IN ADDITION.

ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

NOTE : DO NOT SWITCH DIRECTLY FROM ONE DIRECTION TO THE OTHER, ALLOW MOTOR TO STOP.

DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4.5.1/6

3 PHASE REVERSING  
WITH CONTROL LAMPS

EP 1.3/3.5.1/14

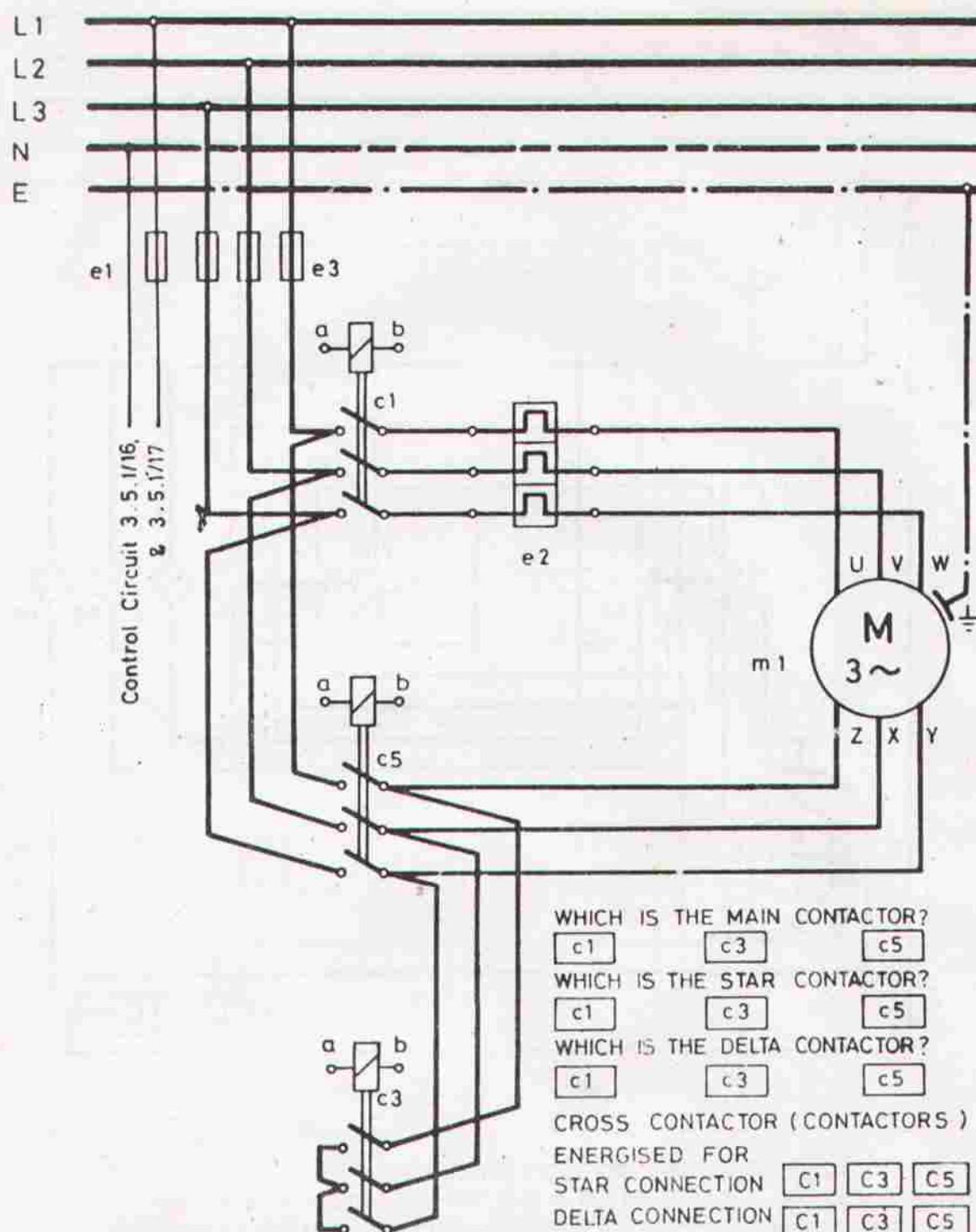
Circuits III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



TAKE SUITABLE MATERIAL (MOTOR) AND DO YOUR PRACTICAL JOB.

EXERCISE SHEET No. 3.5.1/16 AND 3.5.1/17 MAY BE USED IN ADDITION.

ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4, 5.1/7

MOTOR CONNECTION, 3~ STAR-DELTA

EP 1.3/3.5.1/15

Contactors

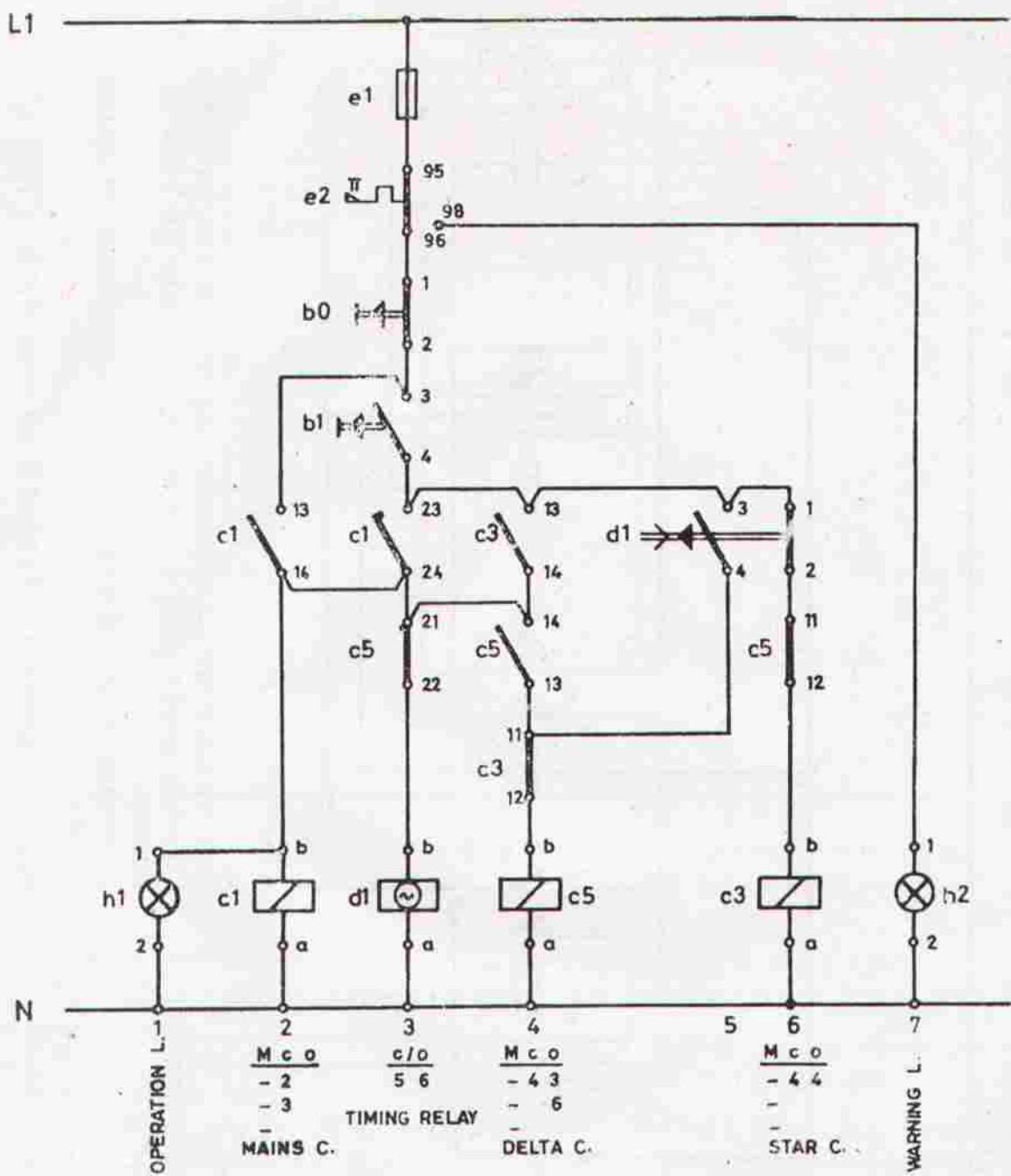


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

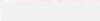
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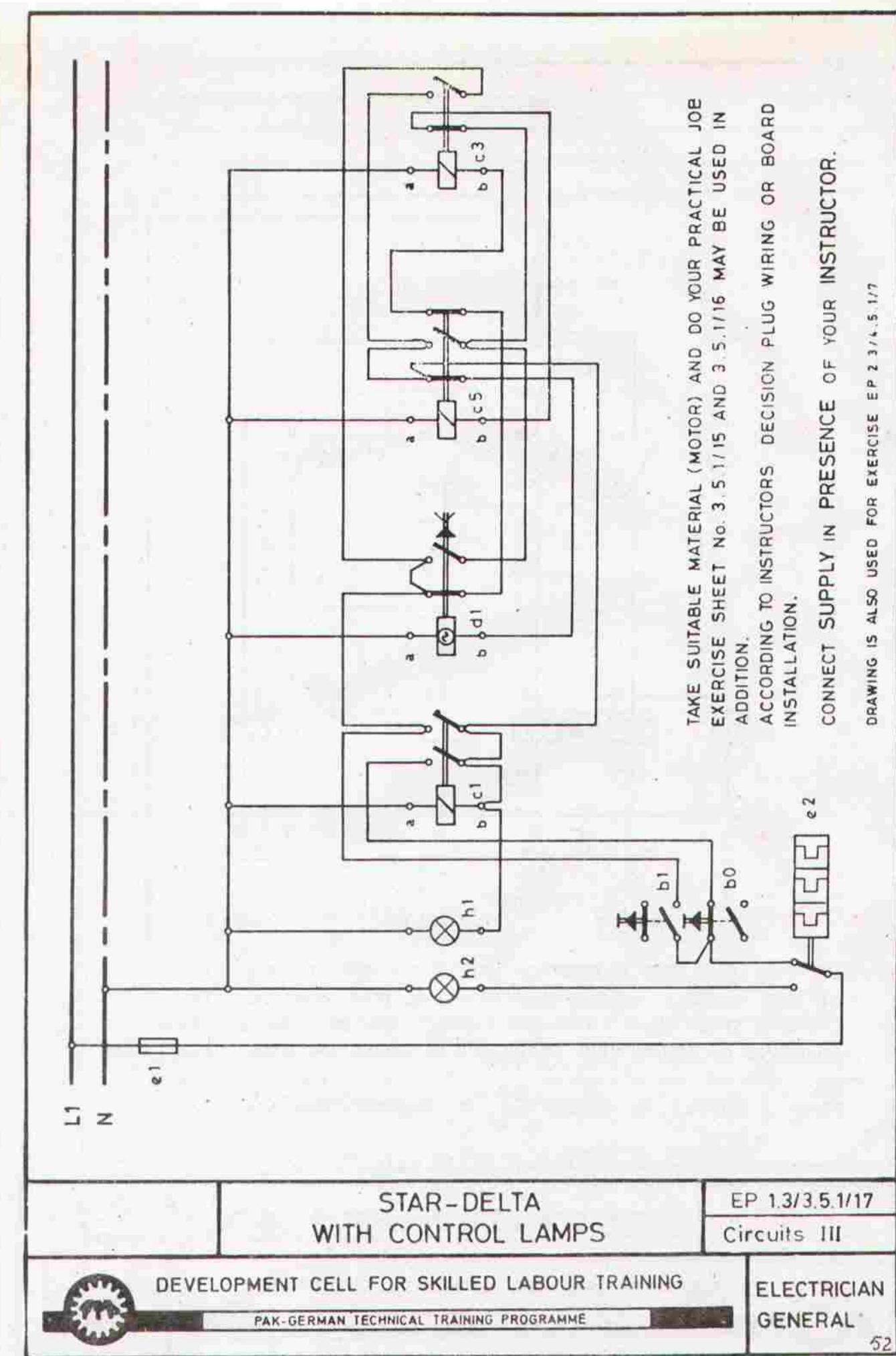


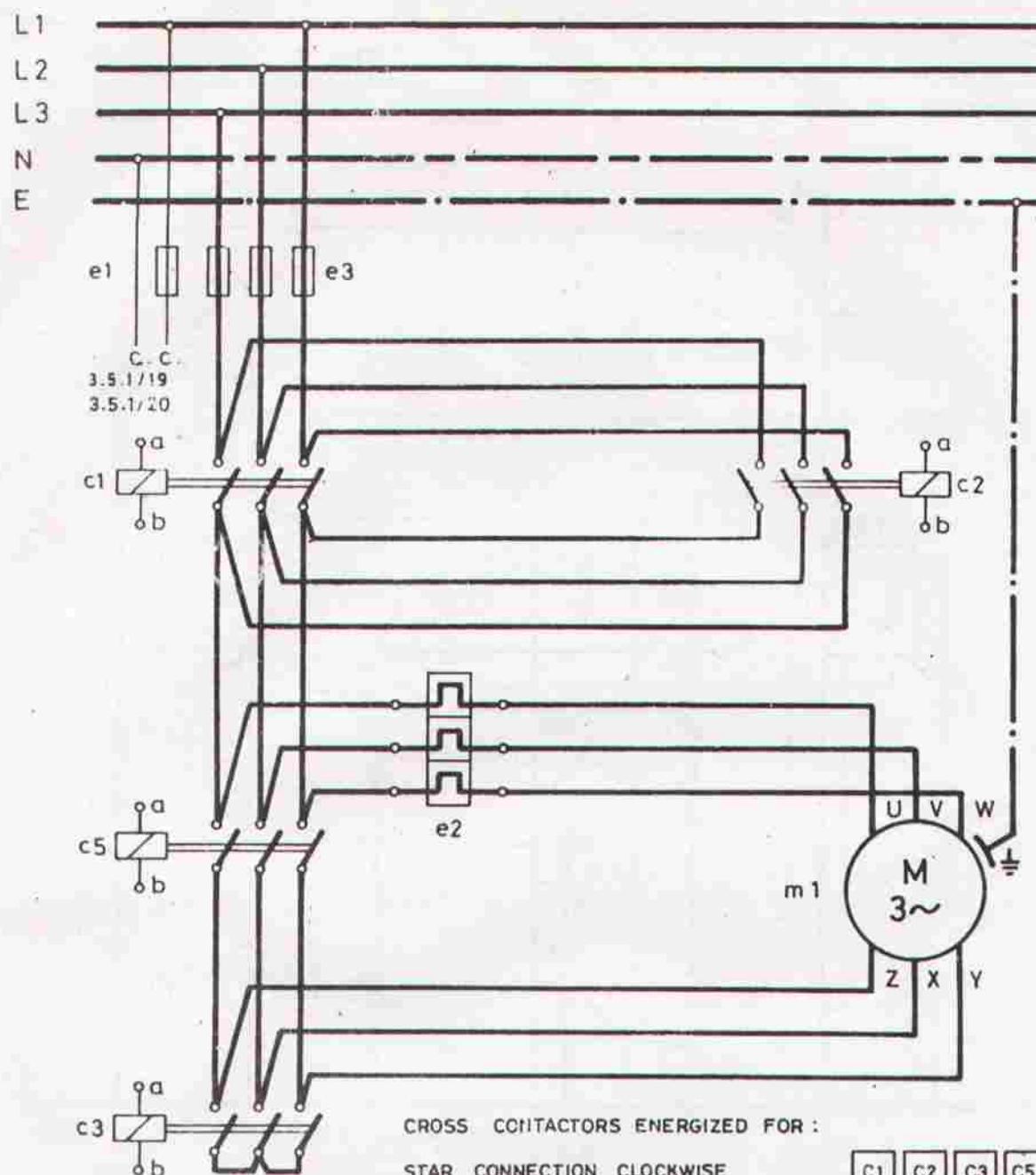
a.) WORK OUT YOUR DESCRIPTION OF CONTROL CIRCUITS 3.5.1/0  
b.) TAKE SUITABLE MATERIAL (MOTOR) AND DO YOUR PRACTICAL JOB.  
EXERCISE SHEET NO 3.5.1/15 AND 3.5.1/17 MAY BE USED IN ADDITION.  
ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4.5.1/7

	MOTOR CONNECTION, 3~STAR-DELTA	EP 1.3/3.5.1/16
		Contactors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING	ELECTRICIAN GENERAL
	PAK-GERMAN TECHNICAL TRAINING PROGRAMME	51



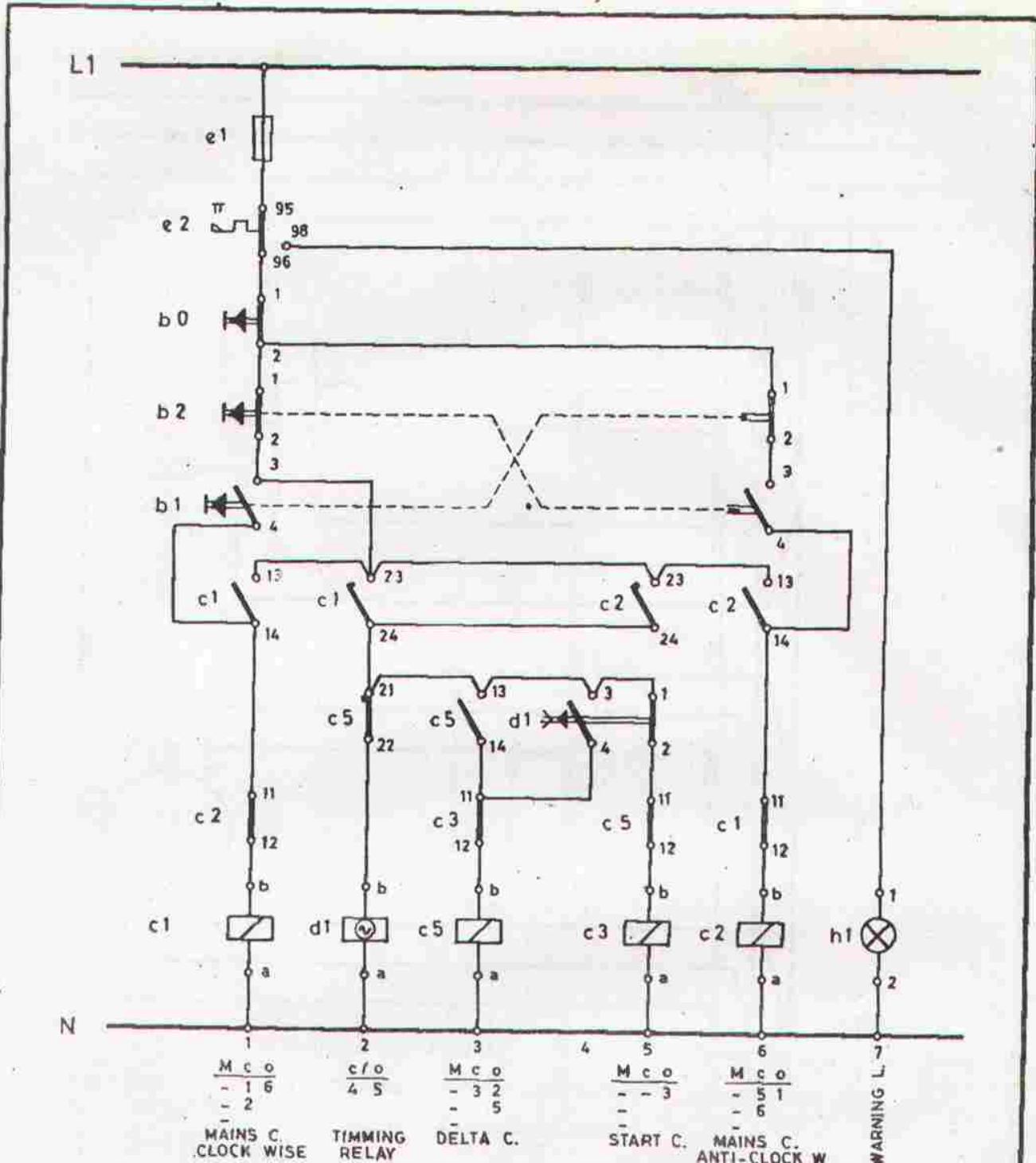


TAKE SUITABLE MATERIAL (MOTOR) AND DO YOUR PRACTICAL JOB.

EXERCISE SHEET NO. 3.5.1/19 AND 3.5.1/20 MAY BE USED  
IN ADDITION.

ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.  
CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR  
DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4.5.1/8

	MOTOR CONNECTION, 3~ STAR DELTA REVERSING	EP 13/3.5.1/18 Contactors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 53



a) WORK OUT YOUR DESCRIPTION OF CONTROL CIRCUITS 3.5.1/0  
 b) EXPLAIN WHY DOES THE CONTROL CIRCUIT CROSS THE DIFFERENT CONTACTS.  
 c) TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.

EXERCISE SHEET No. 3.5.1/18 AND 3.5.1/20 MAY BE USED IN ADDITION.  
 ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4 5.1/8

MOTOR CONNECTION,  
 3~ STAR-DELTA REVERSING

EP 1.3/3.5.1/19

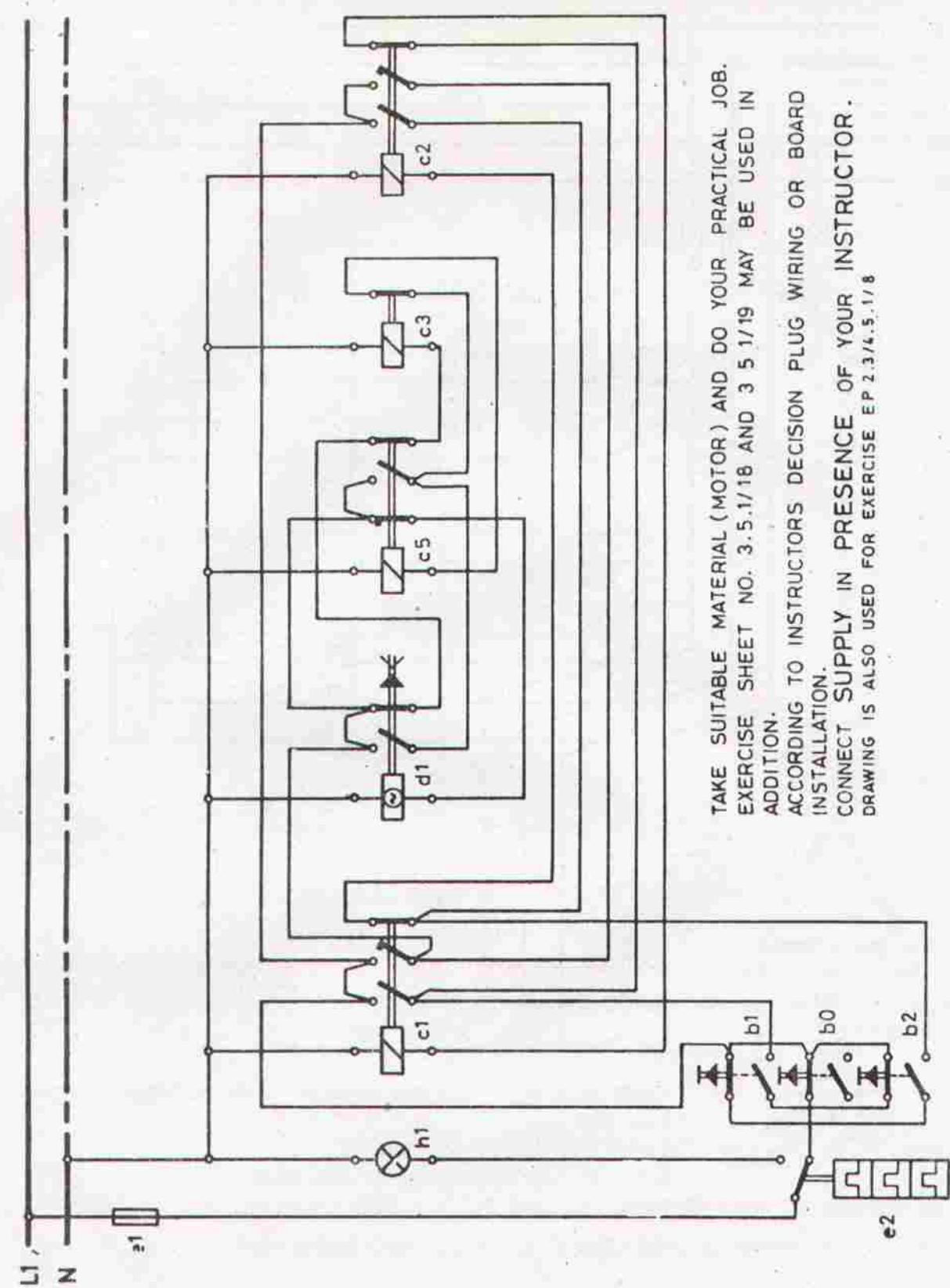
Contactors



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



**STAR-DELTA REVERSING  
WITH CONTROL LAMP**

EP 1.3/3.5 1/20

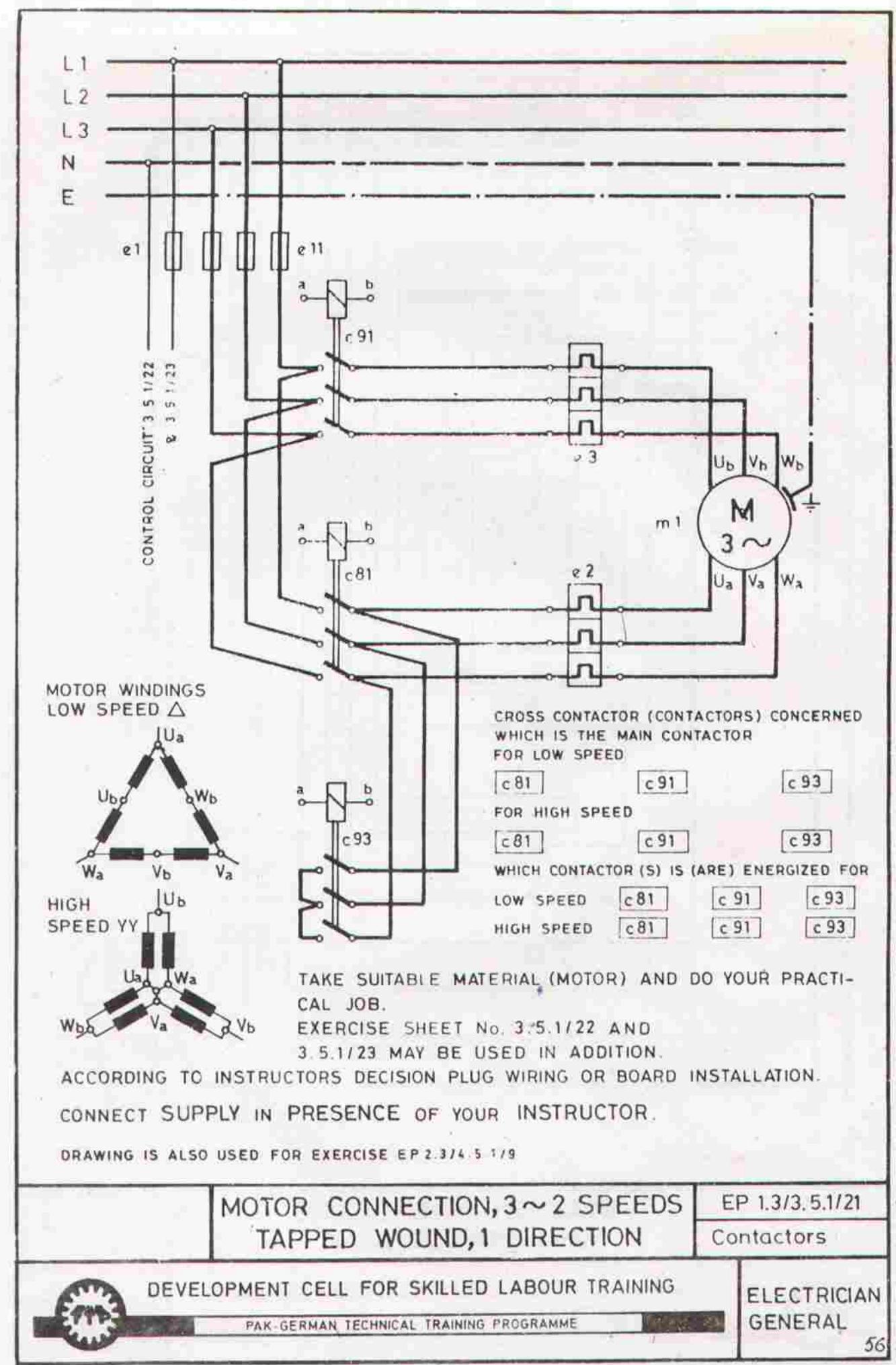
Circuits III

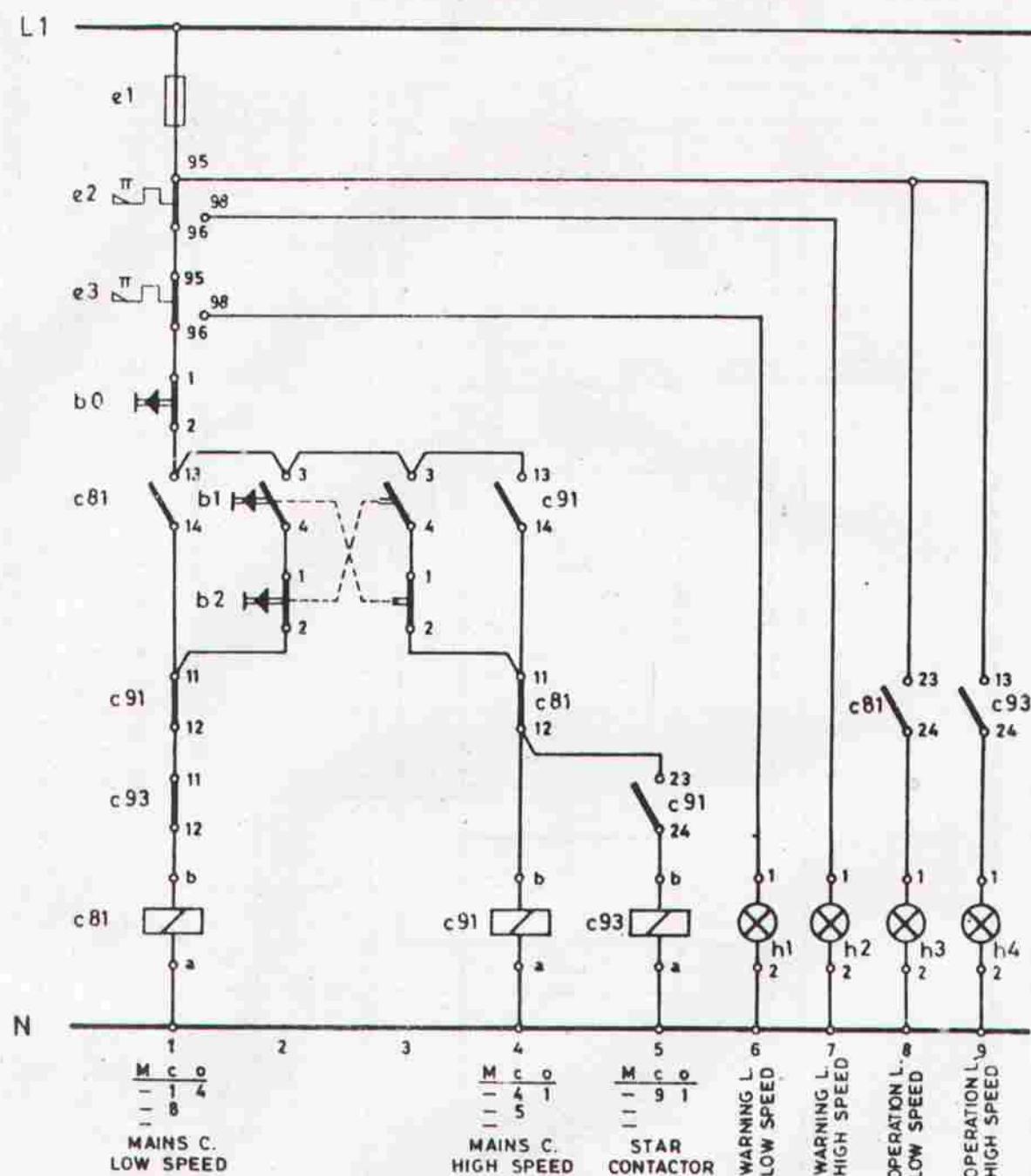


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

**ELECTRICIAN  
GENERAL**



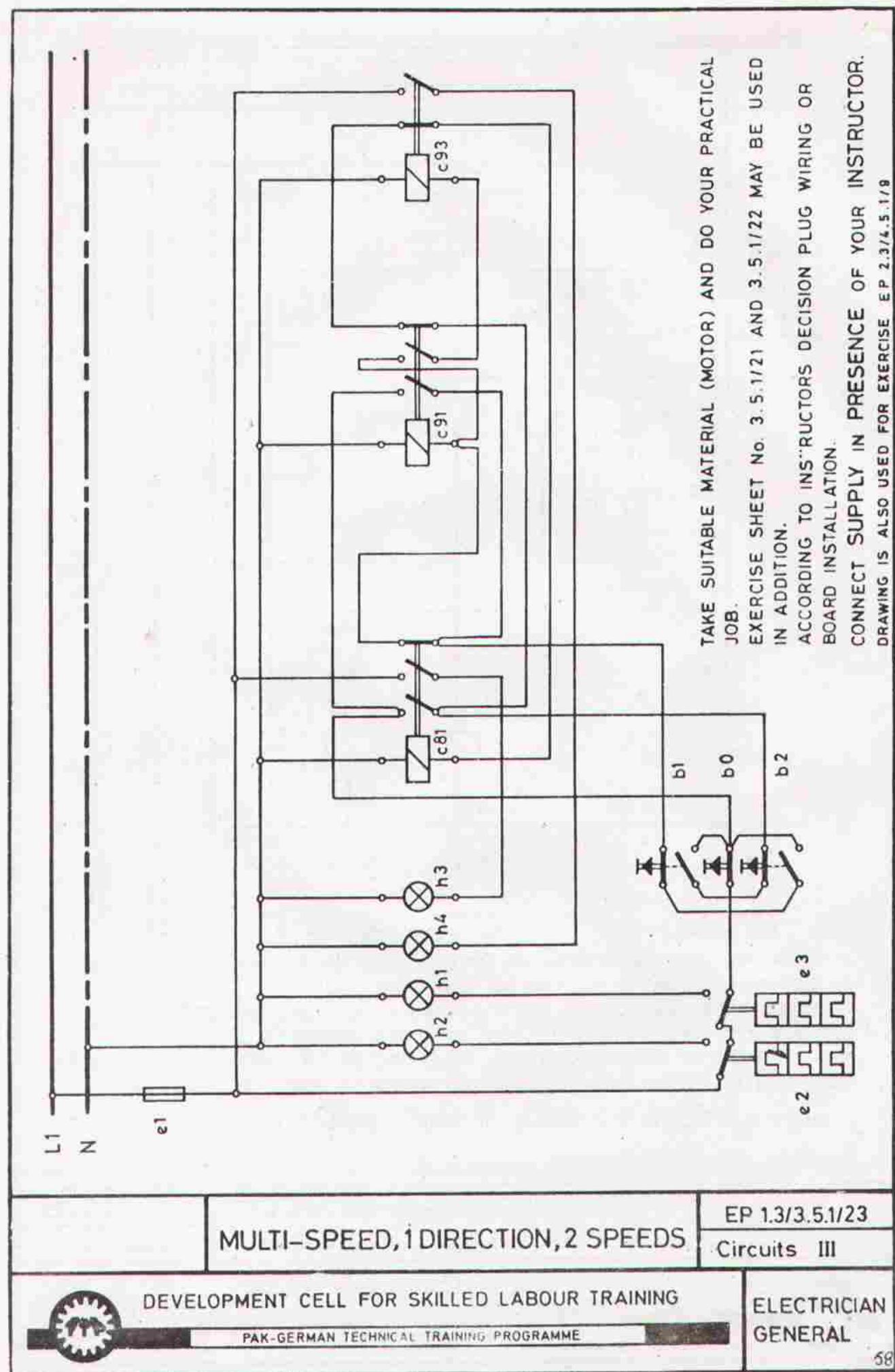


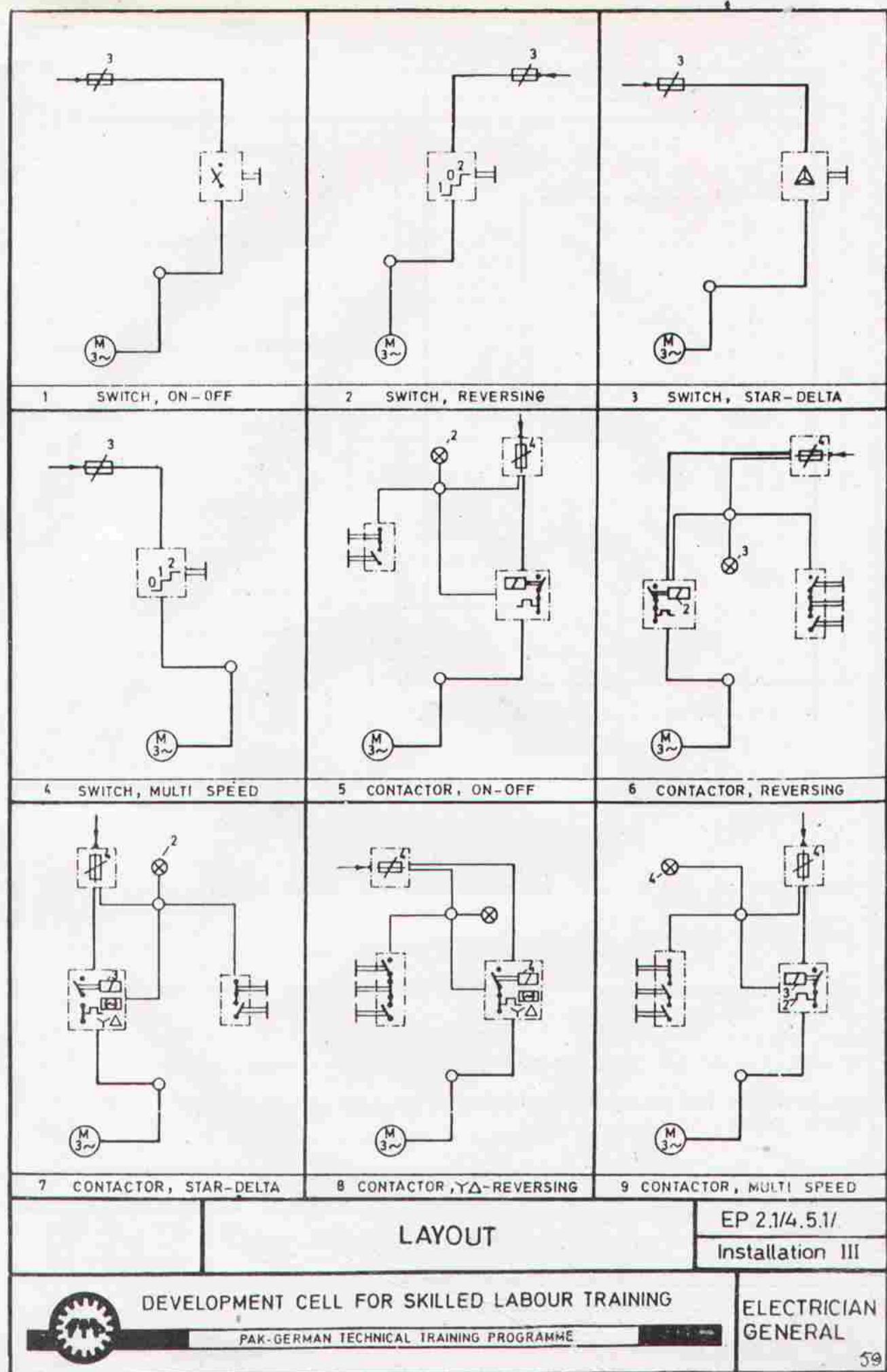
a) WORK OUT YOUR DESCRIPTION OF CONTROL CIRCUITS 3.5.1/0  
 b) TAKE SUITABLE MATERIAL AND DO YOUR PRACTICAL JOB.  
 EXERCISE SHEET No. 3.5.1/21 AND 3.5.1/23 MAY BE USED IN ADDITION.  
 WHY ARE TWO OVERLOAD PROTECTION SWITCHES INSTALLED ?  
 WHAT FOR IS THE INTERLINK SYSTEM PRACTISED ON SWITCHES AND CONTACTORS ?  
 ACCORDING TO INSTRUCTORS DECISION PLUG WIRING OR BOARD INSTALLATION.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

DRAWING IS ALSO USED FOR EXERCISE EP 2.3/4.5.1/9

	MOTOR CONNECTION, 3~ 2 SPEEDS TAPPED WOUND, 1 DIRECTION	EP 1 3/3.5.1/22 Contactors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 57





**MATERIAL:**

- 1 Motor 3~ 380 V
- 3 Fuses (complete)
- 1 Drum Switch 3~ ON - OFF
- 1 Appliance Connection Box
- Cable
- Pipe
- Wire
- Clamps
- Screws
- Connectors

The motor 3~ 380 V is to be connected via fuses and sw. sch.

Take fuses suitable for your motor.

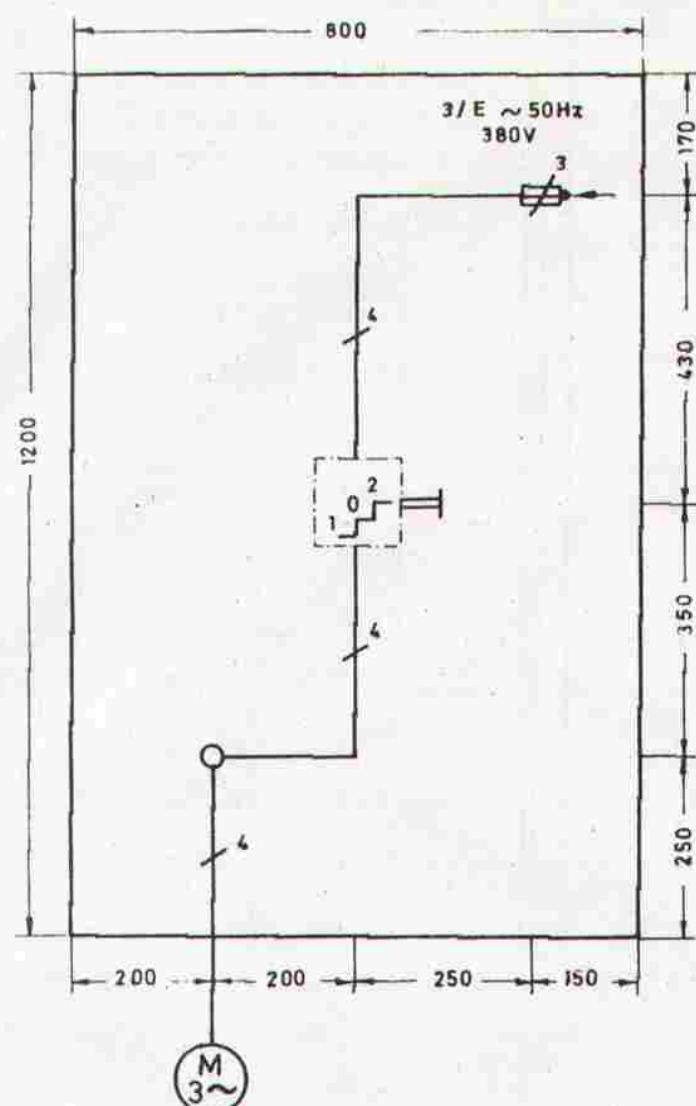
All components are to be installed according to the given drawing and measurements.

Give estimate for the material.

(A suitable motor protection switch should be provided additionally, if available.)

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet. No. 4.5.2/7 may be used in addition	MOTOR CONNECTION, ON-OFF	EP 2.3/4.5.1/1 Installation III
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		ELECTRICIAN GENERAL



## MATERIAL:

- 1 Motor 3~ 380 V
- 3 Fuses (complete)
- 1 Drum Switch 3~ Reversing
- 1 Appliance Connection Box
- Cable
- Pipe
- Wire
- Clamps
- Screws
- Connectors

The Motor 3~ 380 V is to be connected via fuses and reversing switch.

Take fuses suitable for your motor.

All components are to be installed according to the given drawing and measurements.

Give estimate for the material.

(A suitable motor protection switch should be provided additionally, if available.)

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet  
No. 4.5.2/8 may be  
used in addition

## MOTOR CONNECTION, REVERSING

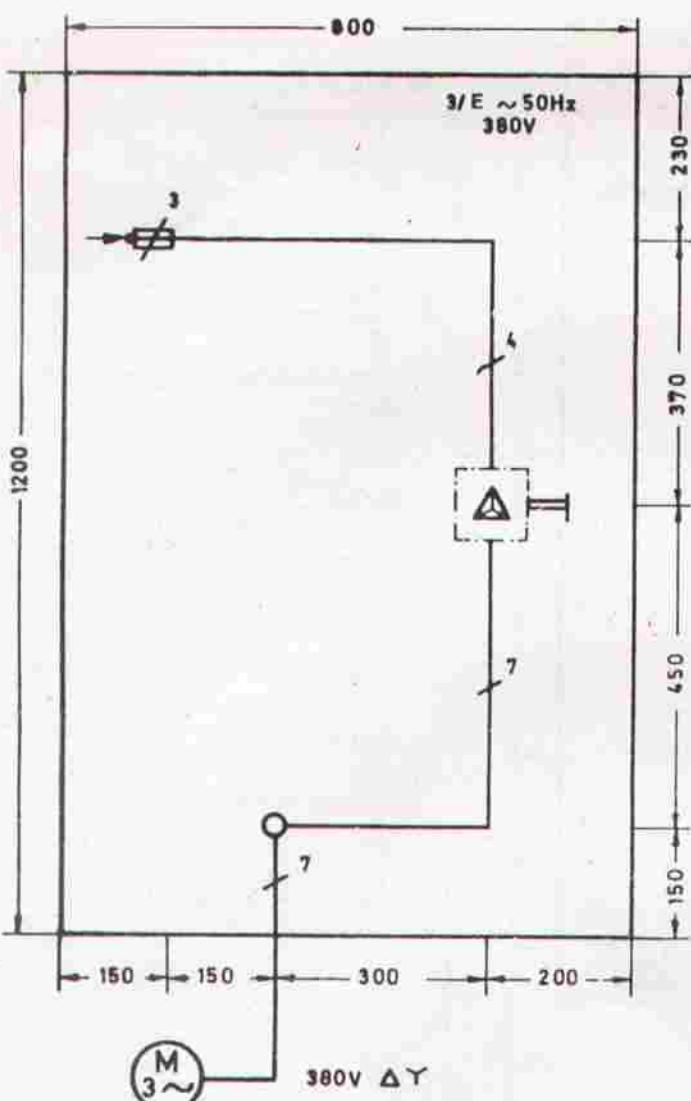
EP 2.3/4.5.1/2  
Installation III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



## MATERIALS

1 Motor 3 ~ 660 / 380 v

### 3 Fuses (complete)

1 Drum Switch 3 ~  
Star - Delta

## 1 Appliance Connection Box

## Cable

## Pipe

## Wire

## Clamps

## Screws

## Connectors

The three-phase motor 660 / 380 V is to be connected via fuses and star - delta switch.

Take fuses suitable for your motor.

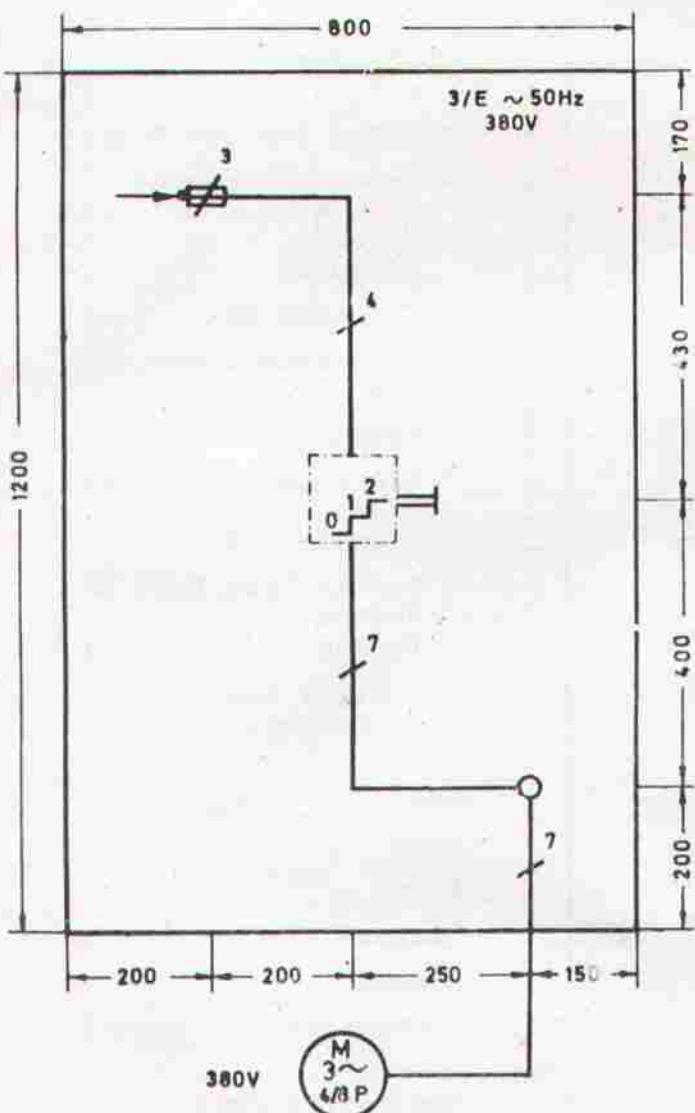
All components are to be installed according to the given drawing and measurements.

Give estimate for the material

(A suitable motor protection switch should be provided additionally, if available.)

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR

Exercise sheet No. 4.5.2/9 may be used in addition	MOTOR CONNECTION, STAR-DELTA	EP 2.3/4.5.1/3 Installation III
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## MATERIAL:

- 1 Motor 3~ 380 V  
(Double Speed 4/8 P)
- 3 Fuses (complete)
- 1 Drum Switch 3~  
Double Speed  
(suitable for your  
motor)
- 1 Appliance Connection  
Box
- Cable
- Wire
- Clamps
- Screws
- Connectors
- Pipe

The three-phase double speed motor 380 V is to be connected via fuses and double speed switch.

Take fuses suitable for your motor.

All components are to be installed according to the given drawing and measurements.

Give estimate for material.

(A suitable motor protection switch should be provided additionally, if available.)

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet  
No. 4.5.2/11 may be  
used in addition

MOTOR CONNECTION, DOUBLE SPEED

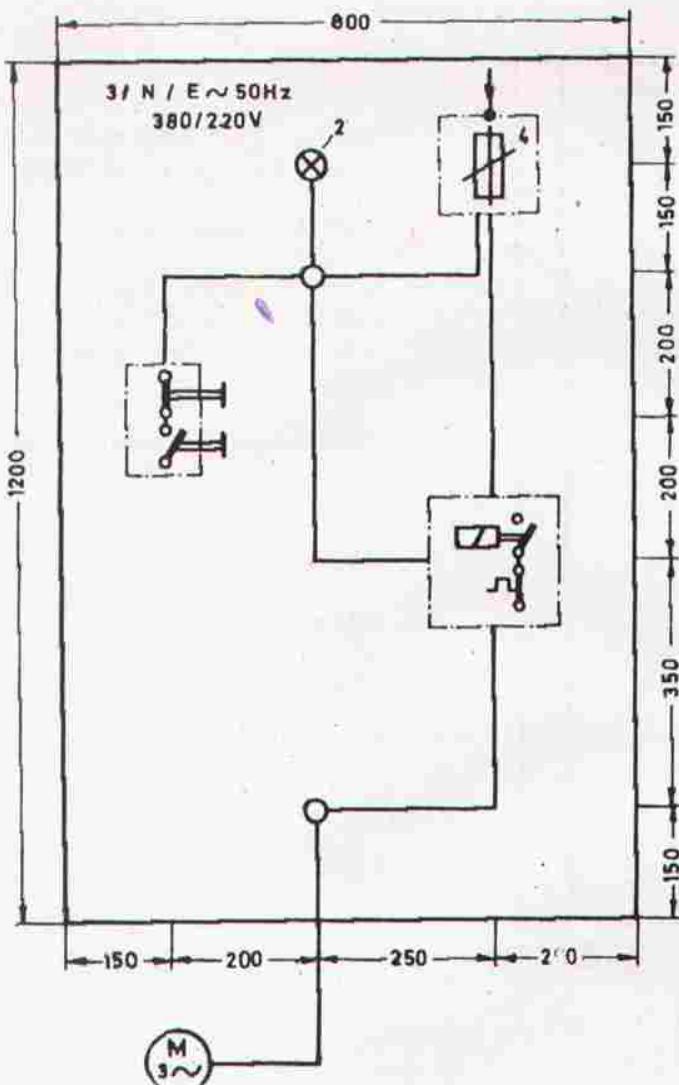
EP 2.3/4.5.1/4  
Installation III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

**MATERIAL:**

- 1 Motor 3~ 380 V  $\Delta$
- 4 Fuses (complete)  
(3 for main or power circuit, 1 for control circuit)
- 1 Junction Box
- 1 Appliance Connection Box
- 1 Automatic Contactor
- 1 Therm. Motor Protection Switch  
(Overload Relay)
- 1 Double Push Button Switch  
(momentary contact)
- 2 Control Lamps  
(complete)
- Cable
- Wire
- Pipe
- Clamps
- Screws
- Connectors

Indicate number of wires in the installation layout

The motor 3~ 380 V is to be connected via fuses, automatic contactor and therm. motor protection switch.

The control circuit consisting of fuse, double push button (momentary contact), control lamps, automatic contactor coil as well as auxiliary contacts and therm. motor protection switch has to be installed as a separate circuit to the power (main) circuit.

All components are to be installed according to the given drawing and measurements.

Take fuses suitable for your motor.

Adjust also therm. motor protection switch.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet  
No. 4.5.3 / 8.9+10 may  
be used in addition

**MOTOR CONNECTION,  
CONTACTOR ON-OFF**

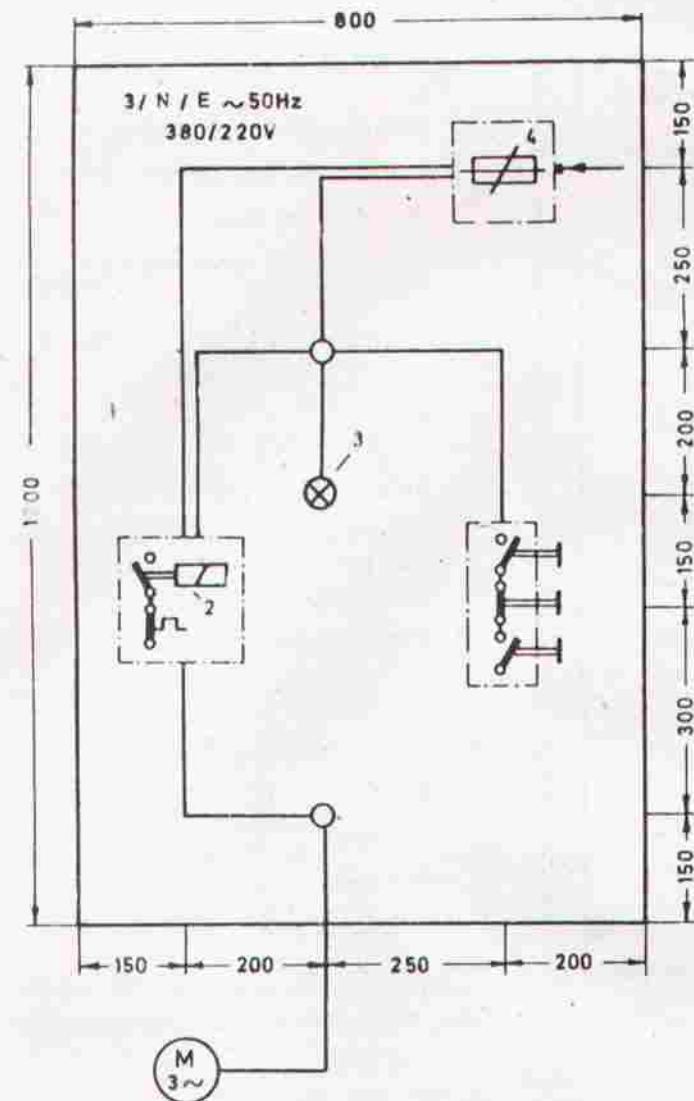
EP 2.3/4.5.1/5  
Installation III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



## MATERIAL:

- 1 Motor 3~ 380 V
- 4 Fuses (complete)
- 1 Junction Box
- 1 Appliance Connection Box
- 3 Control Lamps (compl.)
- 1 Triple Push Button Switch (momentary contact)
- 2 Automatic Contactors
- 1 Therm. Motor Protection Switch (Overload Relay)
- Cable
- Pipe
- Wire
- Clamps
- Screws
- Connectors

Indicate number of wires in the installation layout.

The three-phase motor 380 V is to be connected via fuses, automatic contactor and therm. motor protection switch.

The control circuit consisting of fuse, triple push button switch, control lamps, automatic contactor coils as well as auxiliary contacts and therm. motor protection switch has to be installed as a separate circuit to the power (main) circuit.

All components are to be installed according to the given drawing and measurements.

Take fuses suitable for your motor.

Adjust also therm. protection switch.

Give estimate for material.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet  
No. 4.5.3/11.12+13 may  
be used in addition

MOTOR CONNECTION,  
CONTACTOR REVERSING

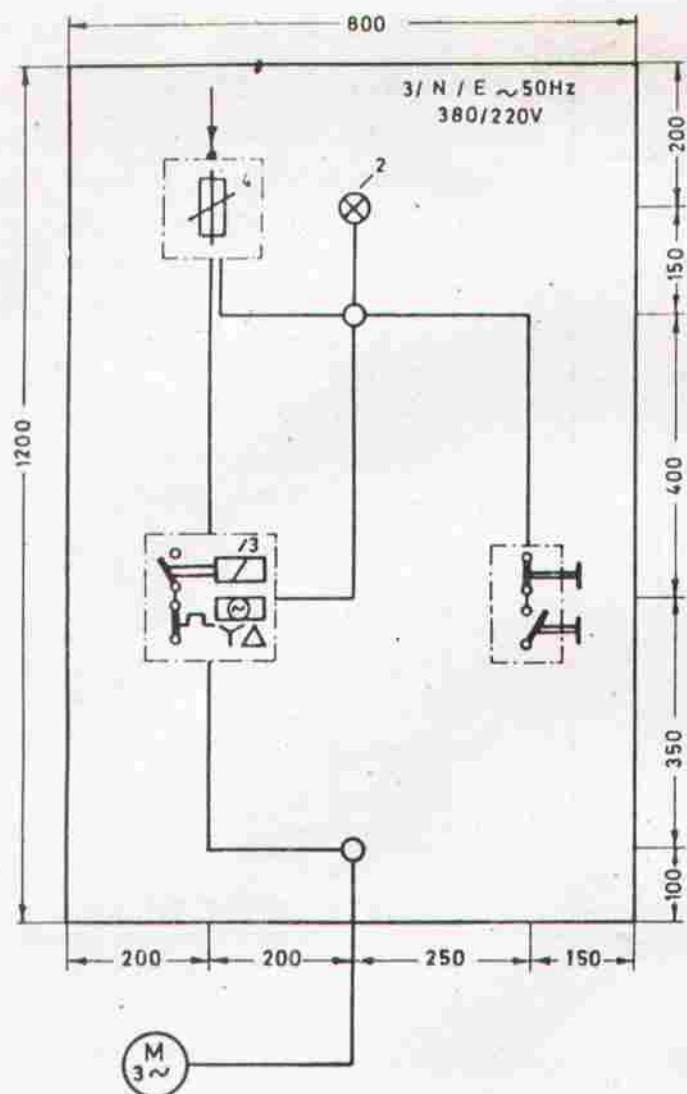
EP 2.3/4.5.1/6  
Installation III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



## MATERIAL:

- 1 Motor 3~ 660/380 V
- 4 Fuses (complete)
- 1 Junction Box
- 1 Appliance Connection Box
- 2 Control Lamps (compl.)
- 1 Double Push Button Switch (momentary contact)
- 3 Automatic Contactors
- 1 Therm. Motor Protection Switch (Overload Relay)
- 1 Timing Relay (Timer)
- Cable
- Pipe
- Wire
- Clamps
- Screws
- Connectors

Indicate number of wires in the installation layout.

The three-phase motor 660/380 V is to be connected via fuses, automatic contactors and therm. motor protection switch.

The control circuit consisting of fuse, double push button switch, control lamps, timer, automatic contactor coils as well as auxiliary contacts and therm. motor protection switch has to be installed as a separate circuit to the power (main) circuit.

All components are to be installed according to the given drawing and measurements.

Take fuses suitable for your motor.

Adjust also therm. motor protection switch.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet  
No. 4.5.3/14, 15+16 may  
be used in addition

MOTOR CONNECTION  
CONTACTOR STAR DELTA

EP 2.3/4.5.1/7

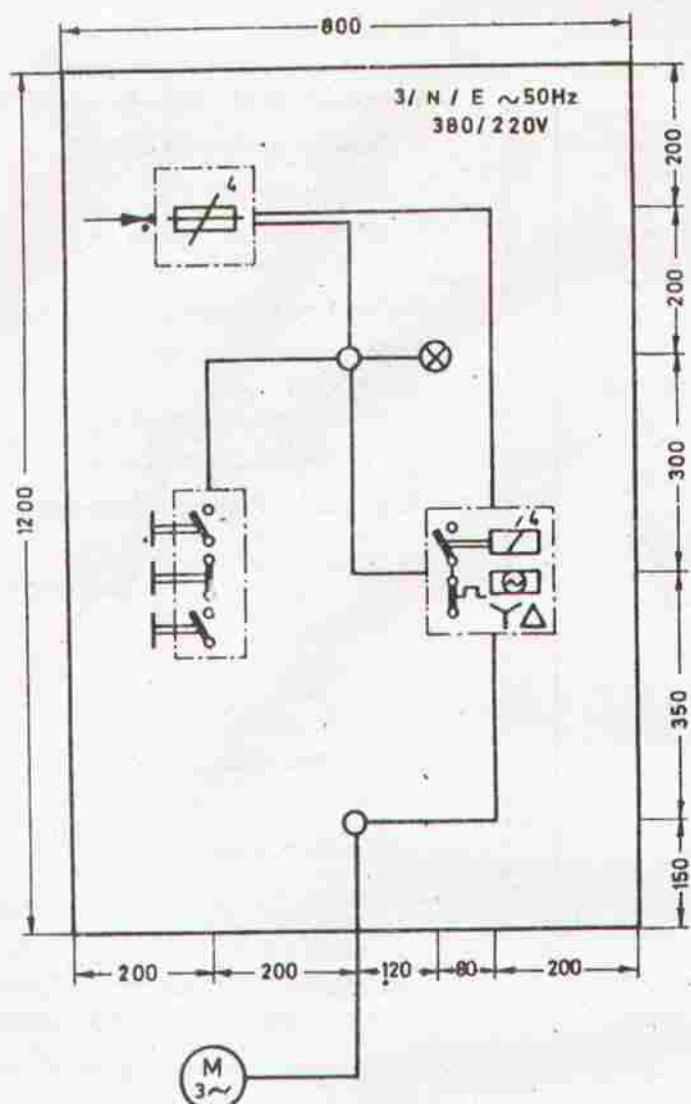
Installation III



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



## MATERIAL:

- 1 Motor 3~ 660/380 V
- 4 Fuses (complete)
- 1 Junction Box
- 1 Appliance Connection Box
- 1 Control Lamp (complete)
- 1 Triple Push Button Switch (momentary contact)
- 4 Automatic Contactors
- 1 Therm. Motor Protection
- 1 Timing Relay (Timer)
- Cable
- Pipe
- Wire
- Clamps
- Screws
- Connectors

Indicate number of wires in the installation layout.

The three-phase motor 660/380 V is to be connected via fuses, automatic contactors and motor protection switch.

The control circuit consisting of fuse, triple push button switch, control lamp, timer, automatic contactor coils as well as auxiliary contacts and therm. motor protection switch has to be installed as a separate circuit to the power (main) circuit.

All components are to be installed according to the given drawing and measurements.

Take fuses suitable for your motor.

Adjust also therm. motor protection switch.

Give estimate for material.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet No. 4.5.3/17, 18 + 19 may be used in addition.	MOTOR CONNECTION, CONTACTOR STAR-DELTA REV.	EP 2.3/4.5.1/8 Installation III
 DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		ELECTRICIAN GENERAL

**MATERIAL:**

- 1 Motor 3~ 380 V 4/8 P
- 4 Fuses (complete)
- 1 Junction Box
- 1 Appliance Connection Box
- 4 Control Lamps (complete)
- 1 Triple Push Button Switch (momentary contact)
- 3 Automatic Contactors
- 2 Therm. Motor Protection Switches (Overload Relay)
- Cable
- Pipe
- Wire
- Clamps
- Screws
- Connectors

Indicate number of wires in the installation layout.

The three-phase double speed motor 380 V is to be connected via fuses, automatic contactors and therm. motor protection switches. The control circuit consisting of fuse, triple push button switch, control lamps, automatic contactor coils as well as auxiliary contacts and therm. motor protection switches has to be installed as a separate circuit to the power (main) circuit. All components to be installed according to the given drawing and measurements. Take fuses suitable for your motor. Adjust also therm. motor protection switch. Give estimate for material.

CONNECT SUPPLY IN PRESENCE OF YOUR INSTRUCTOR.

Exercise sheet No. 4.5.3/20.21+22 may be used in addition	MOTOR CONNECTION, CONTACTOR MULTI-SPEED	EP 2.3/4.5.1/9 Installation III
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		ELECTRICIAN GENERAL

68

## SERVICING ELECTRICAL MOTORS

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DISMANTLING ELECTRICAL MOTORS

REMOVAL OF BALL BEARINGS

INSTALLING OF BEARINGS (2)

REMOVAL OF BUSHES AND SLEEVE BEARINGS

CLEANING OF BALL BEARINGS / TRANSPORTATION

SKIMMING OF ARMATURE

ASSEMBLING OF ELECTRICAL MOTORS

TEST SHEET (MECHANICAL)

TEST SHEET (ELECTRICAL)

CHECK LIST

TYPES OF BEARINGS

TYPES OF LUBRICATION NIPPLES

OIL SEALS

BEARINGS

PARTS OF ELECTRICAL MOTORS

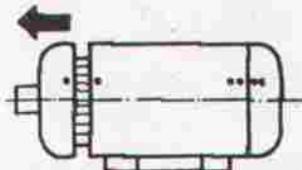
CONSTRUCTION TYPES OF ELECTRICAL MOTORS

## SEQUENCE OF OPERATION

1. Place all motor parts in a box !
2. Work very carefully to avoid damage.
3. Place motor on a clean, level and solid surface, e.g. work bench, concrete floor. Do not open the motor on dirt floor for dirt and dust will enter the motor and cause damage.
4. Clean the outside to remove all dirt and grease with a dry rag, cloth, duster or a brush and some petrol or kerosene oil. **DO NOT USE WATER.**
5. Mark the exact position of both the END SHIELDS and the MOTOR FRAME with a sharp centre punch, scriber or a file. This will help maintain the true bearing alignment when reassembling the motor and prevent mixing up the parts.



6. Take out carbon BRUSHES, if the motor has any, to avoid damaging them.
7. Open nuts or screws with the PROPER SPANNER, or correct size SCREWDRIVER. **DO NOT USE PLIERS.**  
If the screws or nuts are very tight, apply light hammer blows and soften with petrol or kerosene.  
**ATTENTION:** If the nuts or screws are firmly rusted the stud is likely to be twisted off.
8. Open END SHIELD on shaft extension side first. On the opposite side very often the motor lead wires are attached or the centrifugal switch is mounted. Be careful not to tear off the wires from the motor windings or damage the centrifugal switch.
9. Clean inside of the motor carefully with compressed air, rags etc. or a small paint brush with some petrol or kerosene oil. **DO NOT USE WATER** and do not use too much cleaning fluid directly on the windings as it may damage the insulation.  
The use of sharp edged tools, e.g. screwdriver, scraper, knives, inside the motor is **NOT** permitted. For scratching use small pieces of wood or plastic only.
10. Place all parts of the motor in one box. Do not mix parts from other motors or tools with it.  
If parts are not kept in a box they will get lost resulting in an irreparable motor.



	DISMANTLING ELECTRIC MOTORS	EP 2.3/4.5.6/1
		Serv.E.Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN
		GENERAL

The ballbearing is removed from the shaft with a "puller".

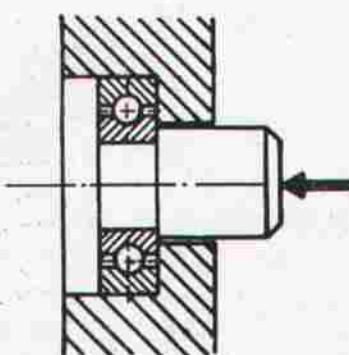
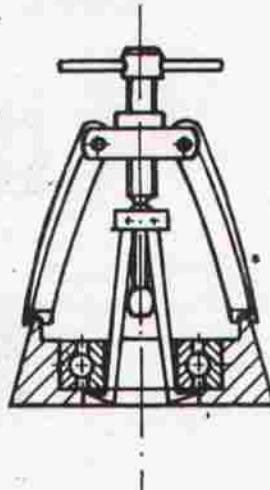
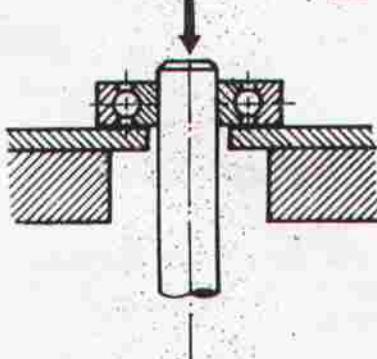
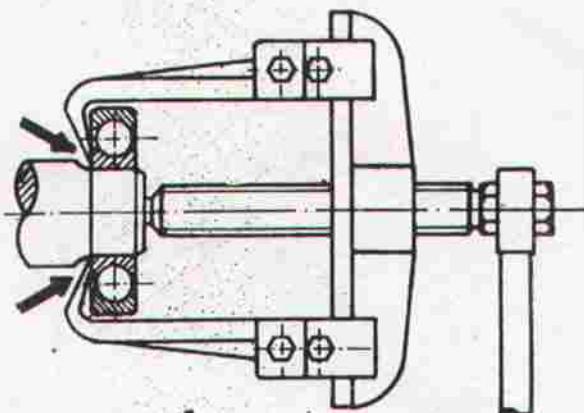
Note: It is very important that only the ring which sits on the shaft is pressed by the puller.

Two strips of flat iron across a vice may be used to remove the bearing. Drive out the shaft with light hammer blows using protective pieces such as wood, copper or aluminium on the shaft end in order to prevent damage to the shaft.

Puller for removing ballbearings from bores.

Careful hammerblows on a piece of soft material, alu, wood etc., may be used to drive the bearing out.

Avoid excessive pressure on the inside ring for it may damage the bearing.



#### REMOVAL OF BALL BEARINGS

EP 2.3/4.5.6/2

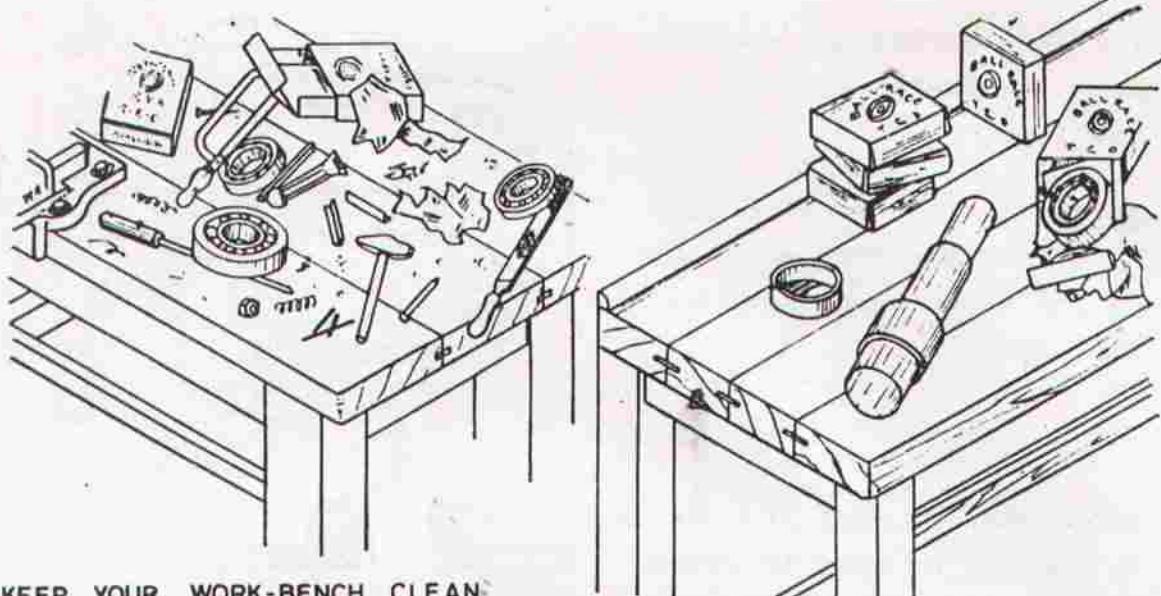
Serv. E. Motors



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL



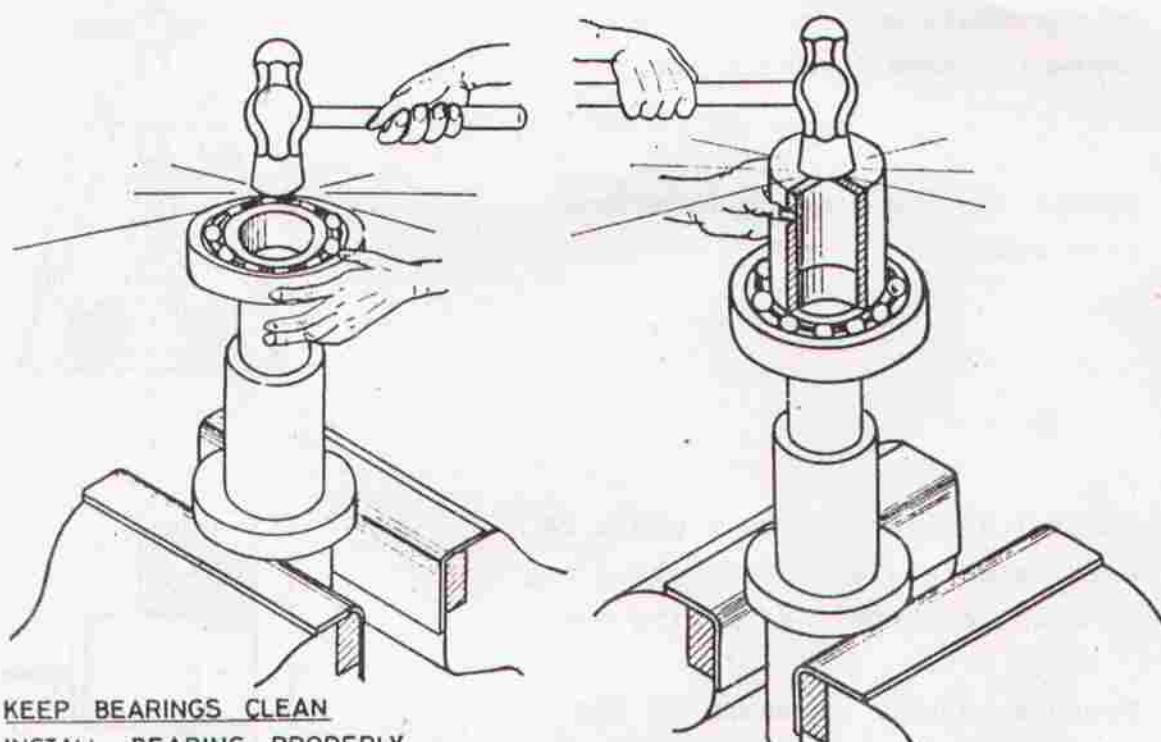
KEEP YOUR WORK-BENCH CLEAN

WRONG

PACKAGE SHOULD NOT BE OPENED AND NEW BEARING EXPOSED TO DIRT BEFORE BEING INSTALLED.

RIGHT

PACKAGE SHOULD BE KEPT CLEAN, AND BEARING SHOULD NOT BE REMOVED UNTIL NEEDED.



KEEP BEARINGS CLEAN

INSTALL BEARING PROPERLY

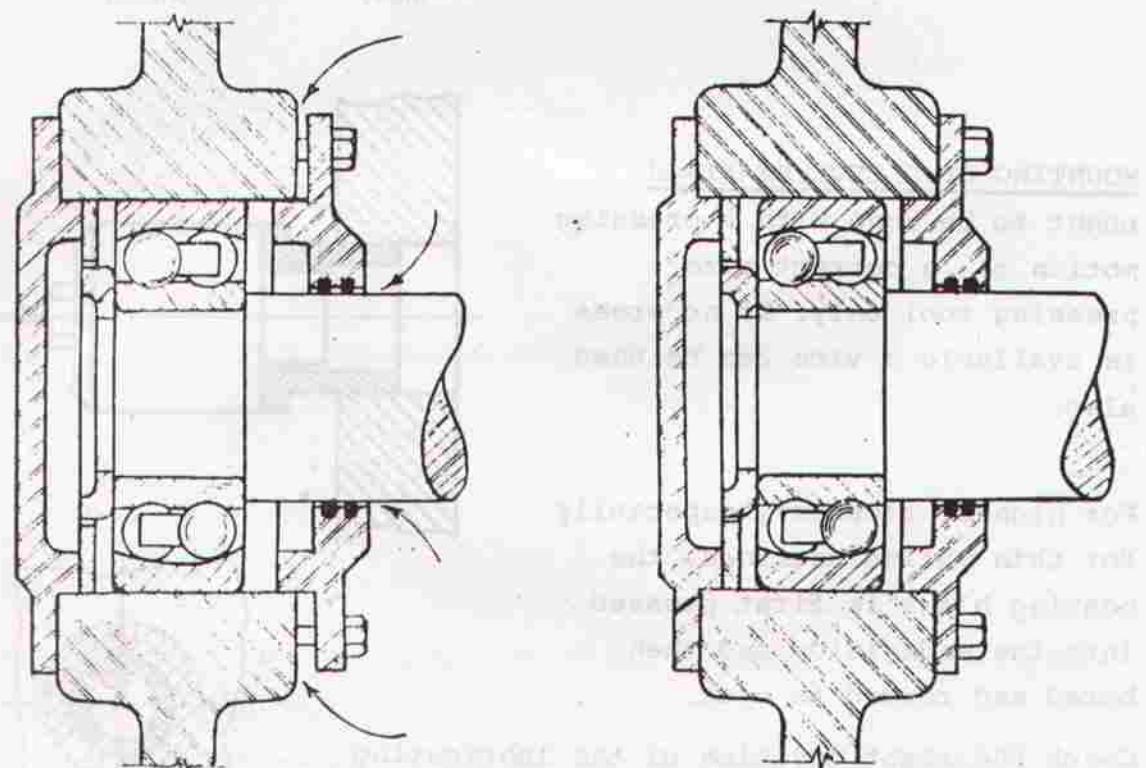
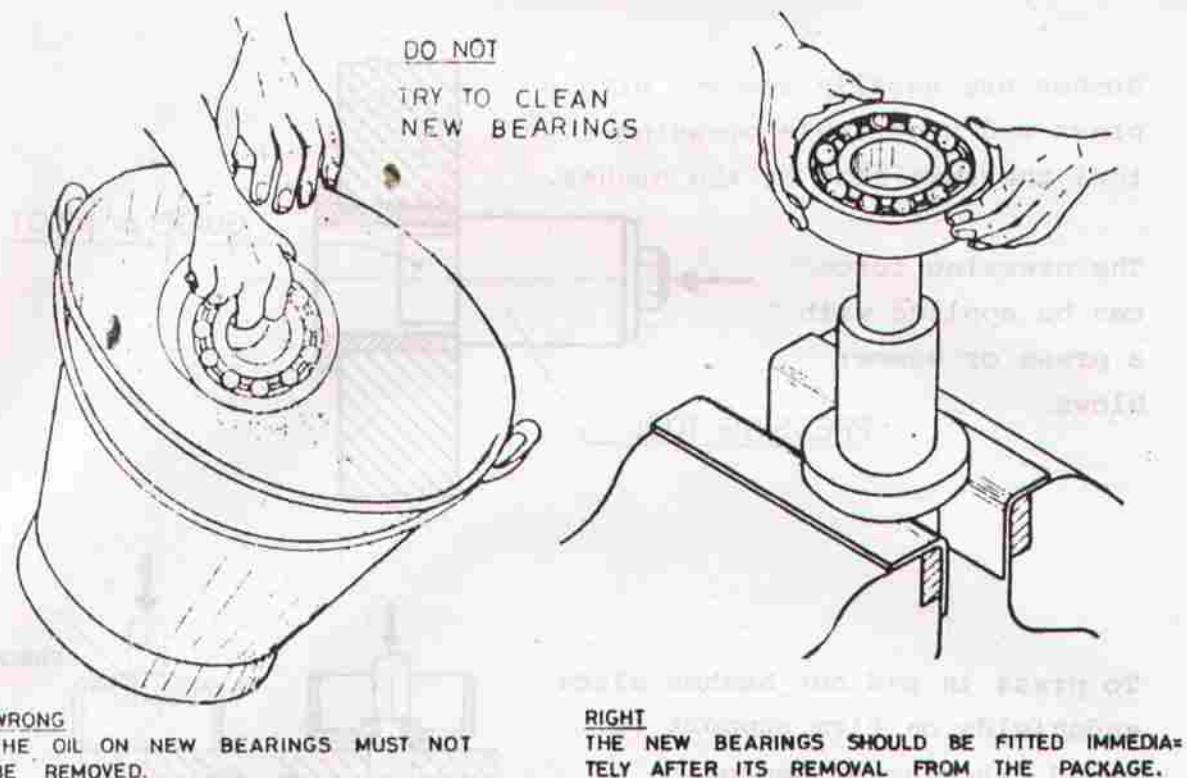
WRONG

BEARING SHOULD NOT BE DRIVEN ONTO SHAFT BY BLOWS ON OUTER CASE.

RIGHT

BEARING SHOULD BE LIGHTLY TAPPED ONTO SHAFT BY BLOWS ON TUBE WHICH FITS AGAINST INNER SLEEVE.

	INSTALLING OF BEARINGS	EP 2.3/4.5.6/3 Serv. E. Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL



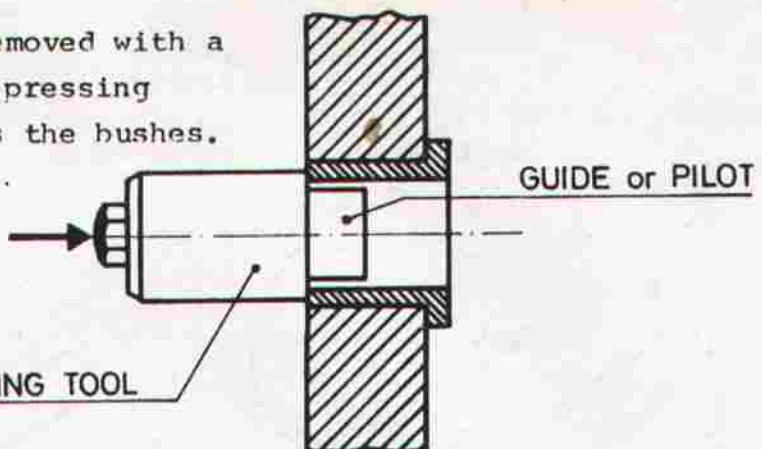
PROTECT OPERATING BEARINGS

	INSTALLING OF BEARINGS	EP 2.3/4.5.6/4 Serv. E. Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 73

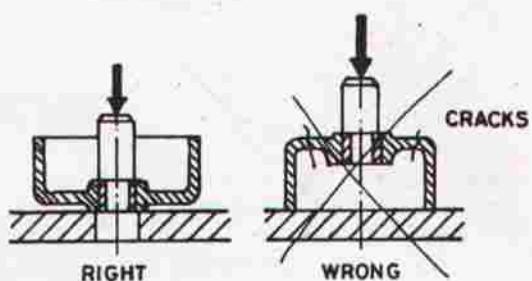
Bushes are usually removed with a press and a suitable pressing tool, the same size as the bushes.

The pressing force can be applied with a press or hammer blows.

PRESSING TOOL



To press in and out bushes place endshields on firm support to avoid cracking or damage.

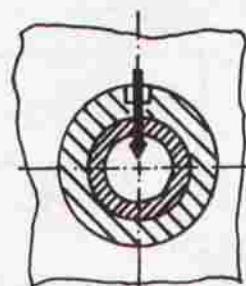
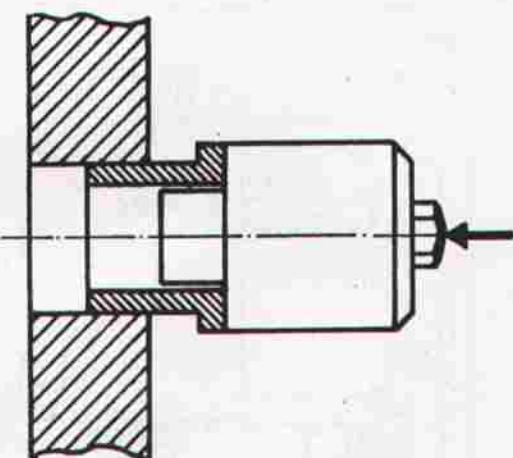


#### MOUNTING OF SLEEVE BEARINGS

ought to be done with a pressing motion of a correct size pressing tool only. If no press is available a vice can be used also.

For highest accuracy, especially for thin walled bearings, the bearing blank is first pressed into the endshields and then bored and reamed to size.

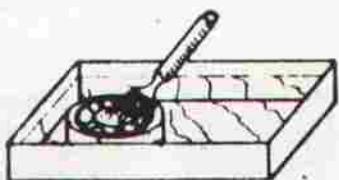
Check the right position of the lubricating hole. If necessary drill the hole after assembling the bearing.



	REMOVAL OF BUSHES AND SLEEVE BEARINGS	EP 2.3/4, 5.6/5 Serv. E. Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL 74

Cleaning a ball bearing

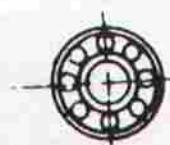
(not applicable for new bearings)



Clean with brush and kerosene or petrol.



Dry with a clean cloth.



Check if clean.



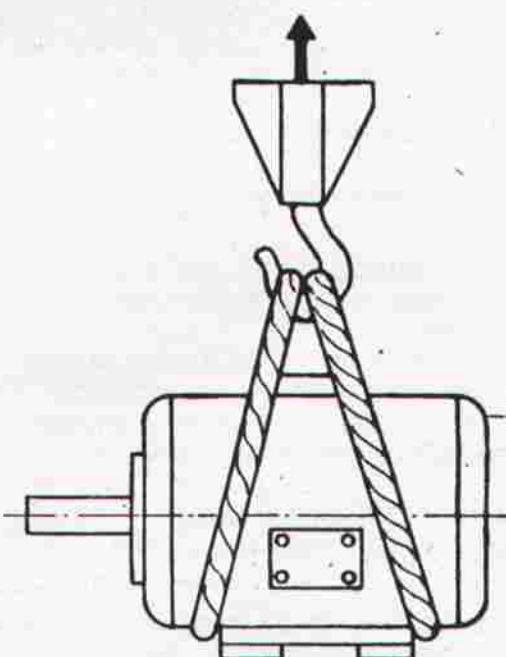
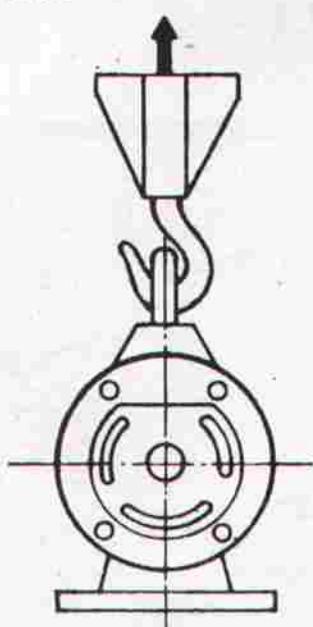
Apply protective oil film and wrap in clean cloth or paper till further use.



Dry with compressed air.



Rinse with fresh petrol or kerosene.



Transportation of heavy motors (lifting)

Attention: Prevent accidents.

Always secure load. Do not stand under lifted load.

CLEANING OF BALL BEARINGS  
TRANSPORTATION

EP 2.3/4.5.6/6

Serv.EI.Motors



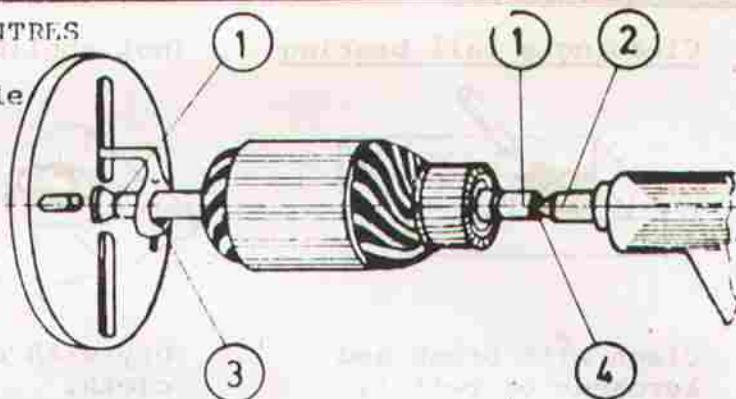
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

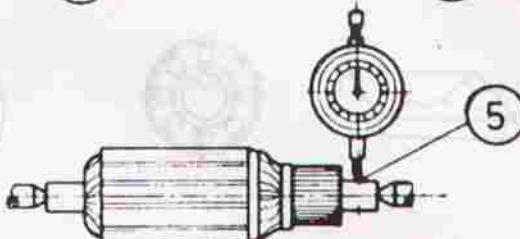
1) MOUNT ROTOR BETWEEN CENTRES

- (1) shaft w. centre hole
- (2) dead centre
- (3) lathe dog
- (4) lubricant



2) CHECK TRUENESS WITH DIAL INDICATOR.

- (5)

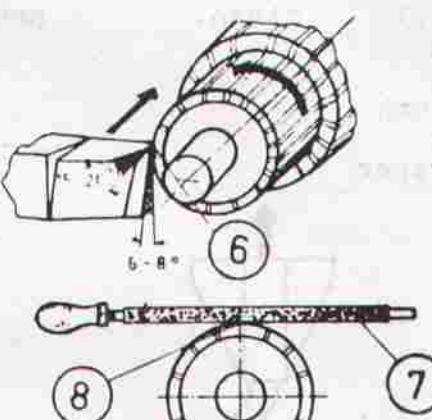


3) CAREFULLY TURN LIGHT CUT

- (6)  $\nabla = 35 \text{ m/min}$        $115 \text{ ft/min}$   
 $\nabla = 30 \text{ m/min}$        $105 \text{ ft/min}$   
 $\nabla = 0.3 - 0.5 \text{ mm/Rev.}$        $0.012 - 0.020$   
 $\nabla = 0.05 - 0.1 \text{ mm/Rev.}$        $0.002 - 0.004$

4) SMOOTHEN WITH EMERY SHEET  
REMOVE ANY BURRS

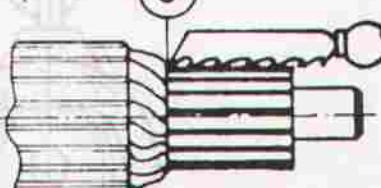
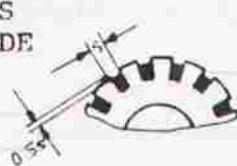
- (7) smooth file
- (8) emery cloth



5) MICA INSULATION MUST BE BELOW THE SURFACE OF THE COMMUTATOR.

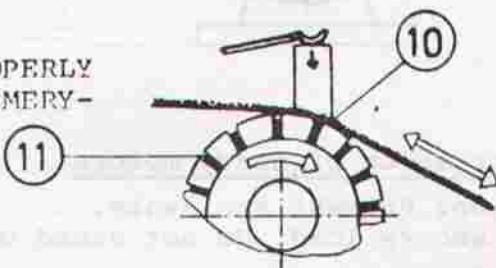
REMOVE THE INSULATING MATERIAL BETWEEN THE SEGMENTS WITH A SPEC. HACKSAW BLADE OF THE SAME THICKNESS !

- (9) hacksaw blade  
mind the winding!



6) TO SEAT THE CARBONBRUSH PROPERLY ON THE COMMUTATOR DRAW AN EMERY-SHEET BETWEEN BRUSH AND COMMUTATOR !

- (10) emery cloth
- (11) undercut mica



SKIMMING OF ARMATURE

EP 2.3/4, 5.6/7  
Serv. El. Motors



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

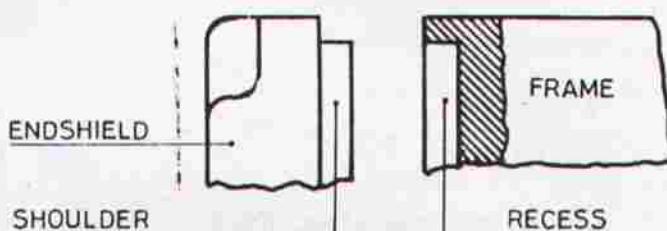
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

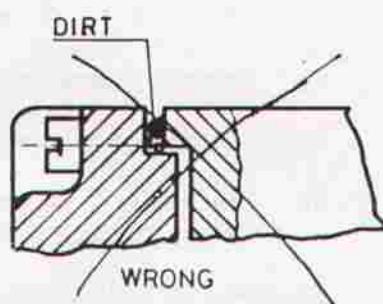
In general the assembling of an E-motor is in the reversed order of the disassembling sequence.

NOTE:

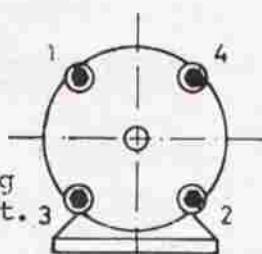
- o Make sure that every part of the motor is clean and in good working order.
- o Fit the centrifugal switch carefully, if any.
- o Do not damage any motor windings.
- o Apply grease to ballbearings only immediately before final assembling.
- o The recess on the frame and the shoulder on the endshields MUST be clean and free from any deposit.



- o Dirt will cause misalignment.



- o Tighten bolts or nuts crosswise.
- o Use wooden hammer to tap endshields with light hammer blows while turning the shaft to obtain maximum alignment.



ASSEMBLING OF ELECTRIC MOTORS

EP 2.3/4.5.6/8  
Serv. E. Motors

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

QUALITY CONTROL

All serviced and repaired motors are to be checked thoroughly both mechanically and electrically.

ONLY MOTORS IN PERFECT CONDITION ARE TO BE RELEASED !

Checklist: (mechanical)

	correct	tight (small)	loose (big)
1) Noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) End play	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) Rotor running free	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) Bearing fits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) Lubrication, grease nipples, oil supply	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6) Temperature bearings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7) Temperature motor frame	<input type="checkbox"/>	<input type="checkbox"/> (fair)	<input type="checkbox"/> (unusable)
8) Condition of shaft, key way, pulley, bearing seals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9) Bolts, nuts tightened	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10) Test run 30 min.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Final remarks:

Signature/ Date

	TEST SHEET (MECHANICAL)	EP 2.3/4.5.6/9 Serv.EI.Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL

## QUALITY CONTROL

All serviced and repaired motors are to be checked thoroughly both mechanically and electrically.

ONLY MOTORS IN PERFECT CONDITION ARE TO BE RELEASED.

MANUFACTURER		
MOTOR-NR	TYP	
YEAR OF CONST	SYST OF PROTECTION	
V	A	COS $\phi$
RPM	Hz	HP
kW		

Type of motor: A.C. D.C. single phase polyphase

#### Checklist (electrical)

1) Fill in above type plate:

2) Measure and check:      Voltage: \_\_\_\_\_ V

                                    Current: \_\_\_\_\_ A

                                    Resistance: \_\_\_\_\_ Ω

                                    Revolution: \_\_\_\_\_ RPM

                                    Insulation:

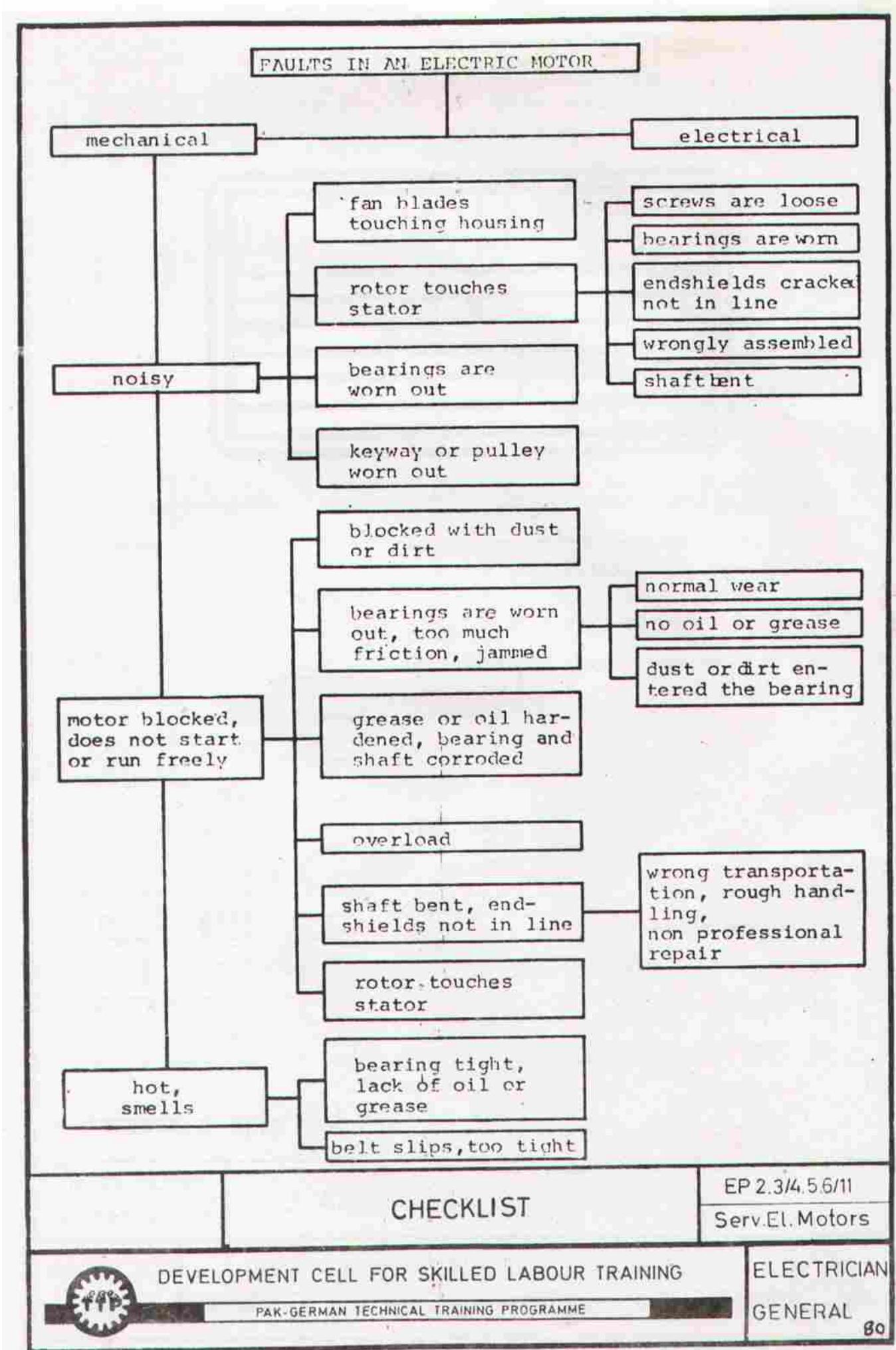
                                    Earth:      good      too low      too high

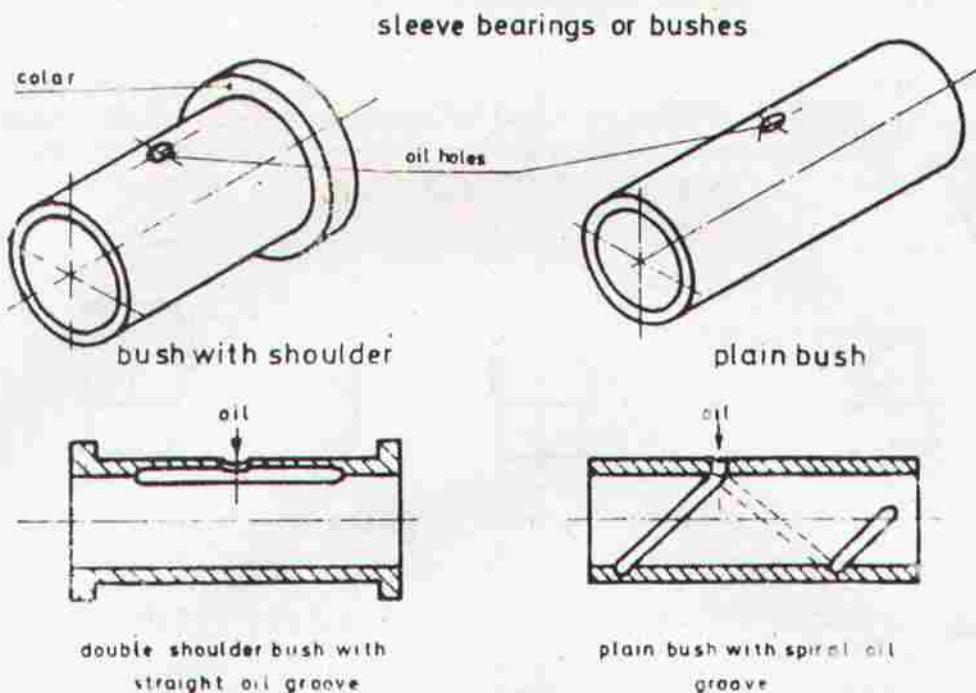
3) Temperature:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4) Noise:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5) Power output:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6) Testrun 30 min.:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remarks:

Sign sure / Date

	TEST SHEET(ELECTRICAL)	EP2.3/4. 5.6/10 Serv.EI. Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL



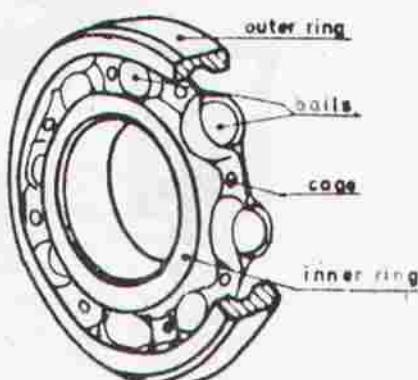


SLEEVE BEARINGS or BUSHES are turned from brass, gun metal bronze or special bearing metals. Sleeve bearing motors are usually oil lubricated and are generally used in horizontal position.

"OIL LESS" bushes are considered as permanently lubricated. In this arrangement the shaft passes through a sintered (powdered metal which is pressed and baked in an oven) bushing which has been impregnated with oil. No lubrication is needed. Used in fans etc.

ball bearing

BALL BEARINGS are manufactured from special steel and are precisely machined and ultra precisely ground. The balls and the actual running faces are highly polished.



SEALED BEARINGS contain lifetime lubrication and should not be opened.

	ELECTRIC MOTORS TYPES OF BEARINGS	EP 2.3/4.56/12 Serv. El. Motors
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL

LUBRICATION OF ELECTRIC MOTORS

Moving parts need to be lubricated to reduce friction which causes heat.

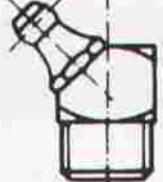
Heat may spoil the bearing.

Bearings in electric motors need a constant supply of clean oil or grease. The lubricant is supplied through specially designed oil supply holes commonly fitted with the following oil or grease nipples:

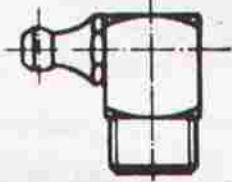
Form A



Form B



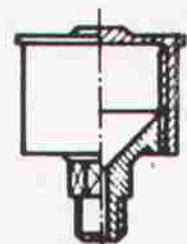
Form C



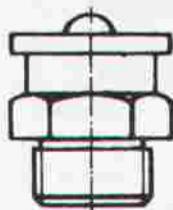
ball-valve grease nipples

To be served with a grease gun only.

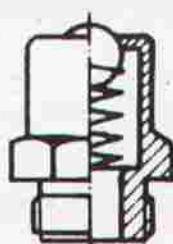
NOTE: clean nipples carefully before lubricating.



stauffer type  
grease cup



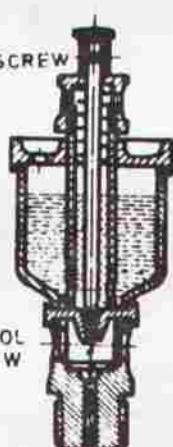
oil nipple



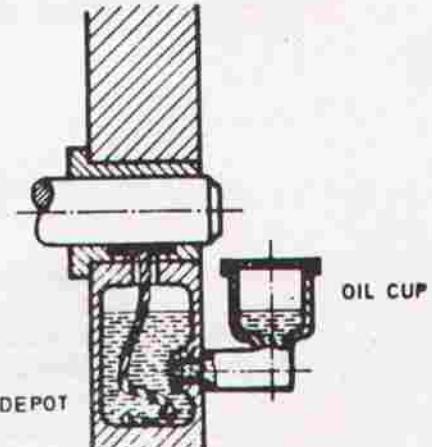
oil nipple



wick oiler  
(lubricator)



sight feed  
lubricator



OIL CUP  
OIL DEPOT

wick oiler  
(lubricator)

**TYPES OF LUBRICATION NIPPLES**

EP 2.3/4.5.6/13

Serv.El.Motors



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

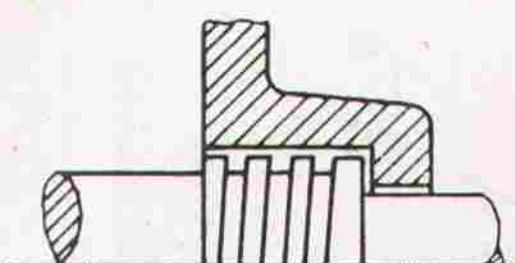
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN

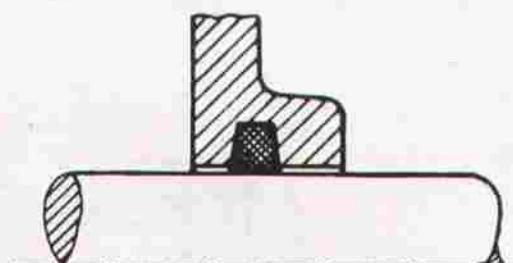
GENERAL

82

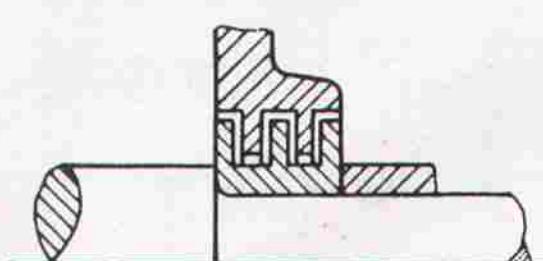
NON CONTACTING OIL SEAL



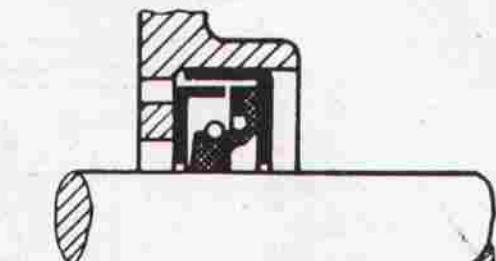
CONTACTING OIL SEAL



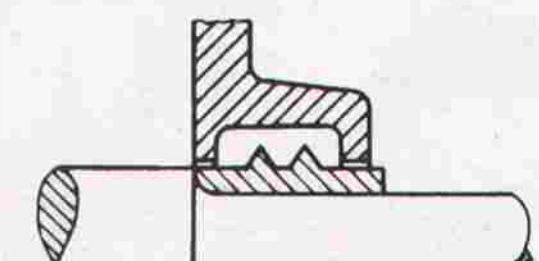
CONVEYOR SPIRAL



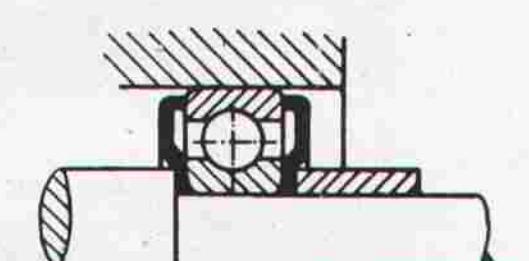
FELT RING SEAL



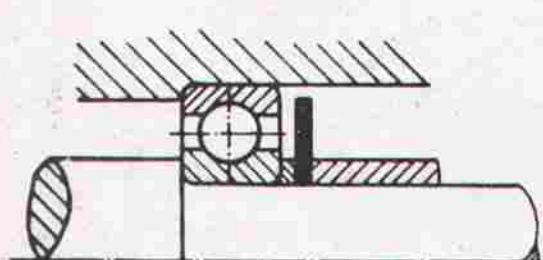
LABYRINTH BOX



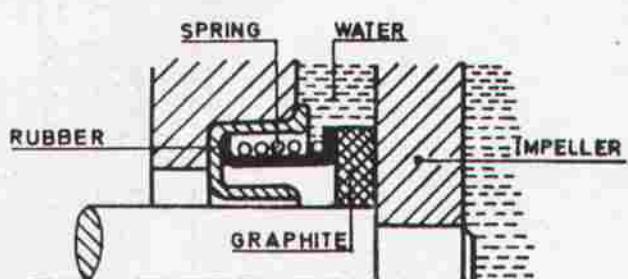
ELASTIC OIL SEAL



OIL THROWER



SEALED BALL BEARING



RETAINING RING

WATER PUMP SEAL

ELECTRIC MOTORS  
OIL SEALS

EP 2.3/4.5.6/14

Serv.El.Motors

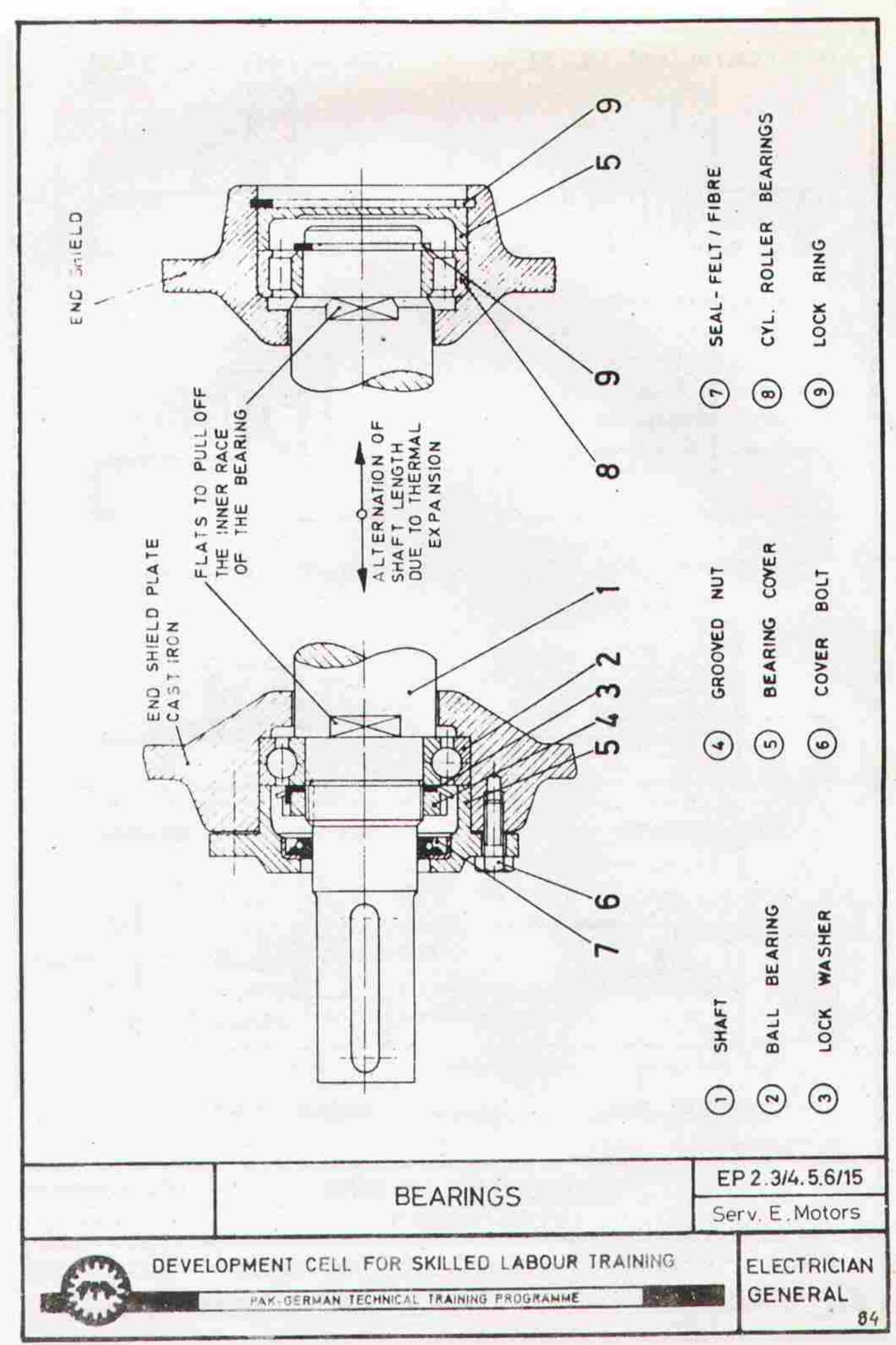
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

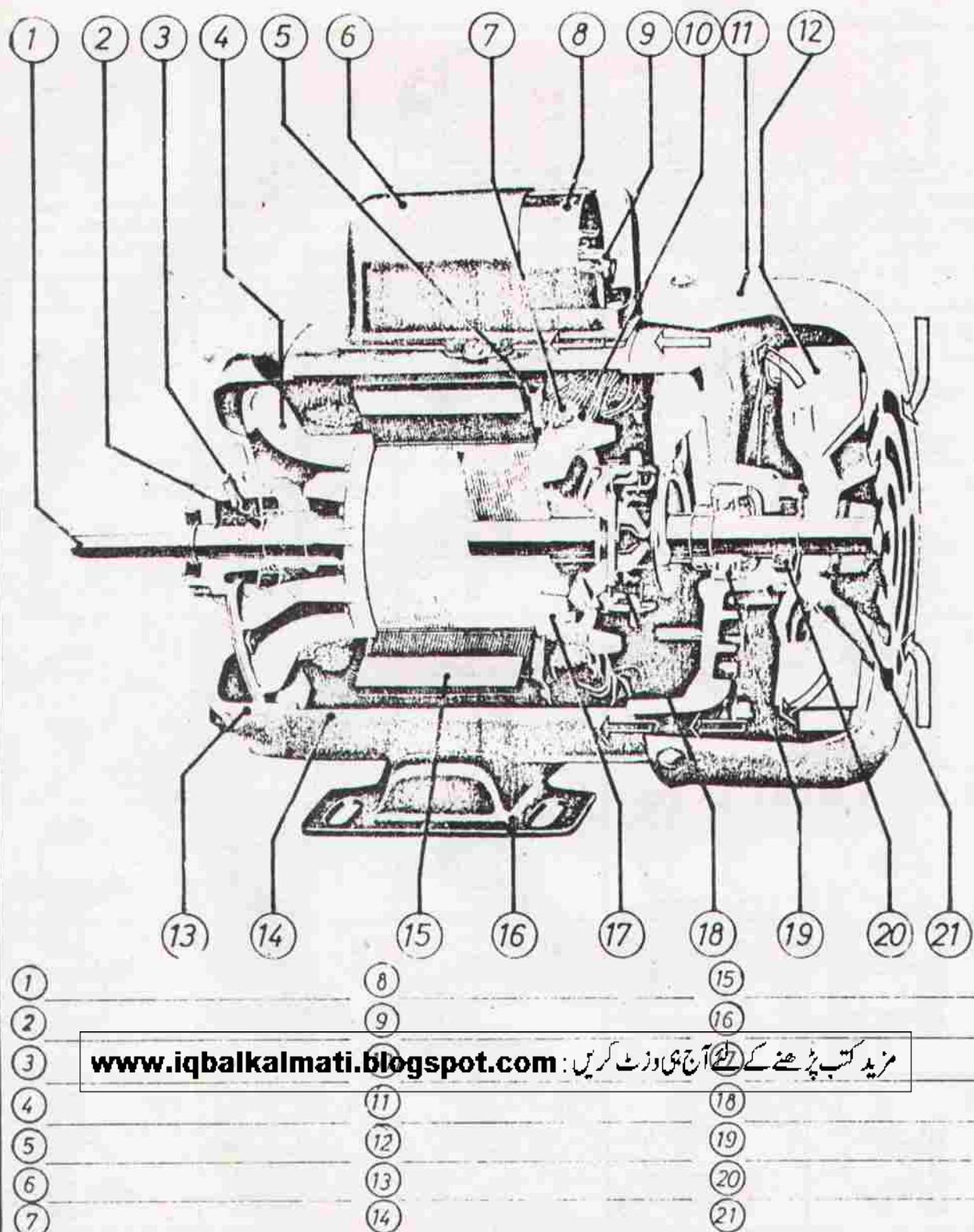
ELECTRICIAN



PAK-GERMAN TECHNICAL TRAINING PROGRAMME

GENERAL





PARTS OF ELECTRIC-MOTOR

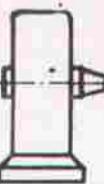
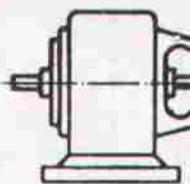
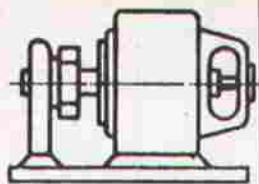
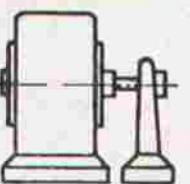
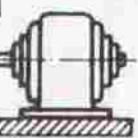
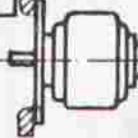
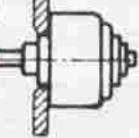
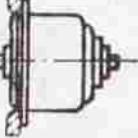
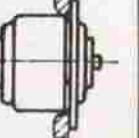
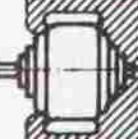
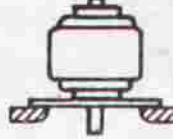
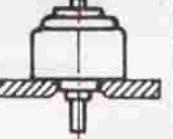
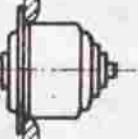
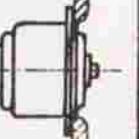
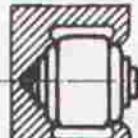
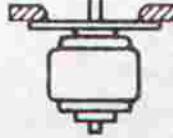
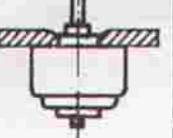
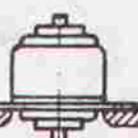
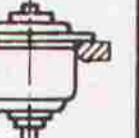
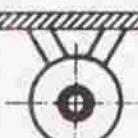
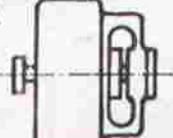
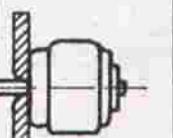
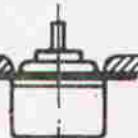
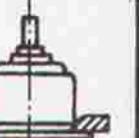
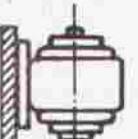
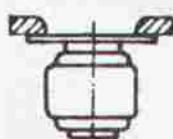
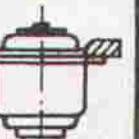
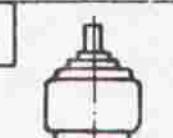
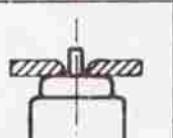
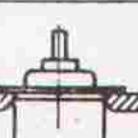
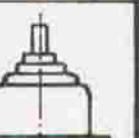
EP 2.3/4.5.6/16  
Serv. El. Motors

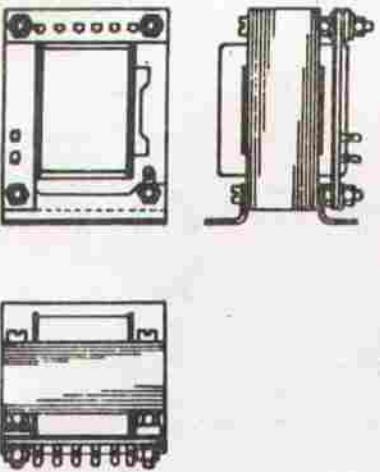
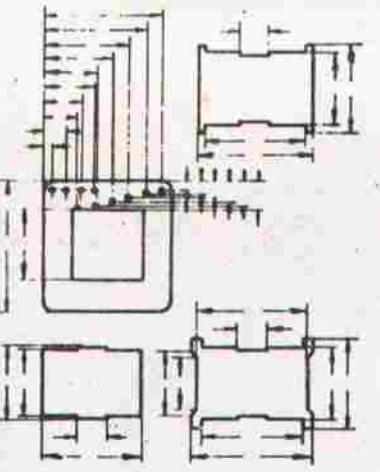
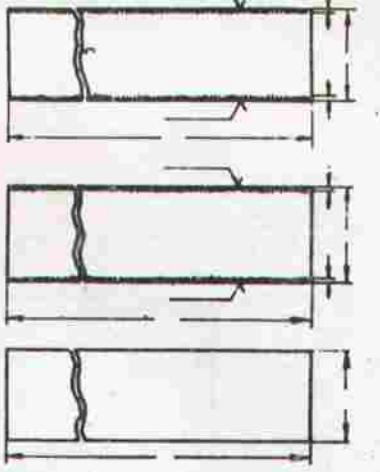
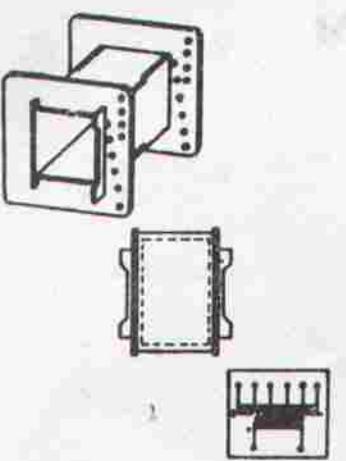
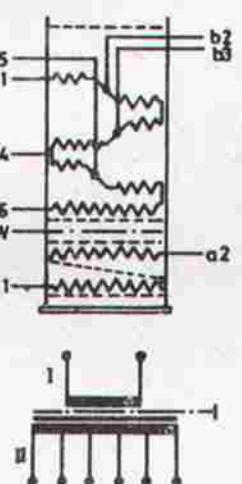
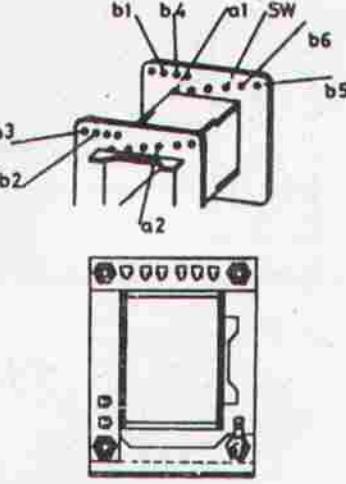
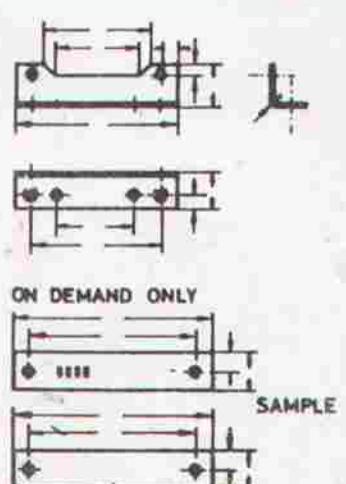


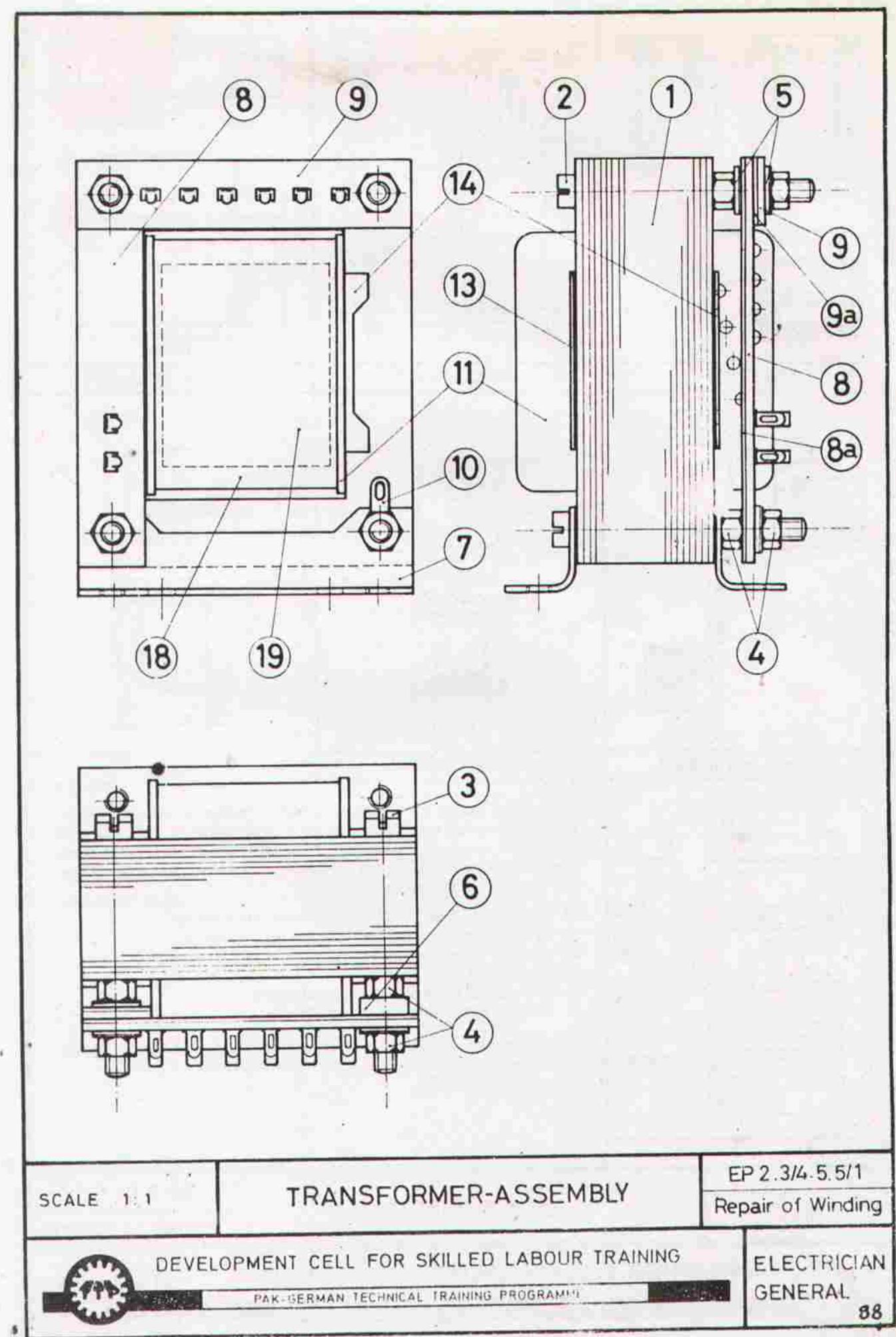
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

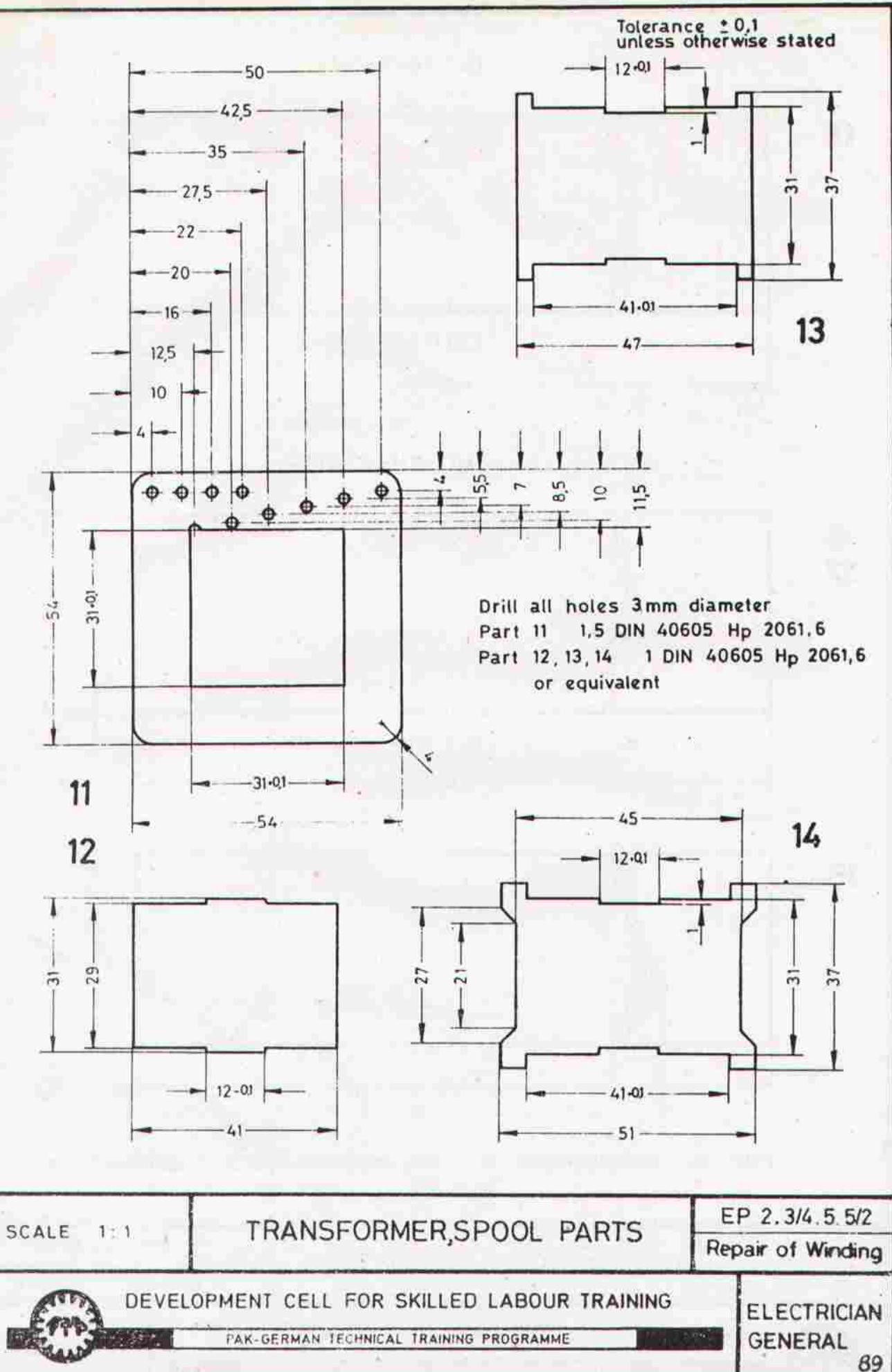
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

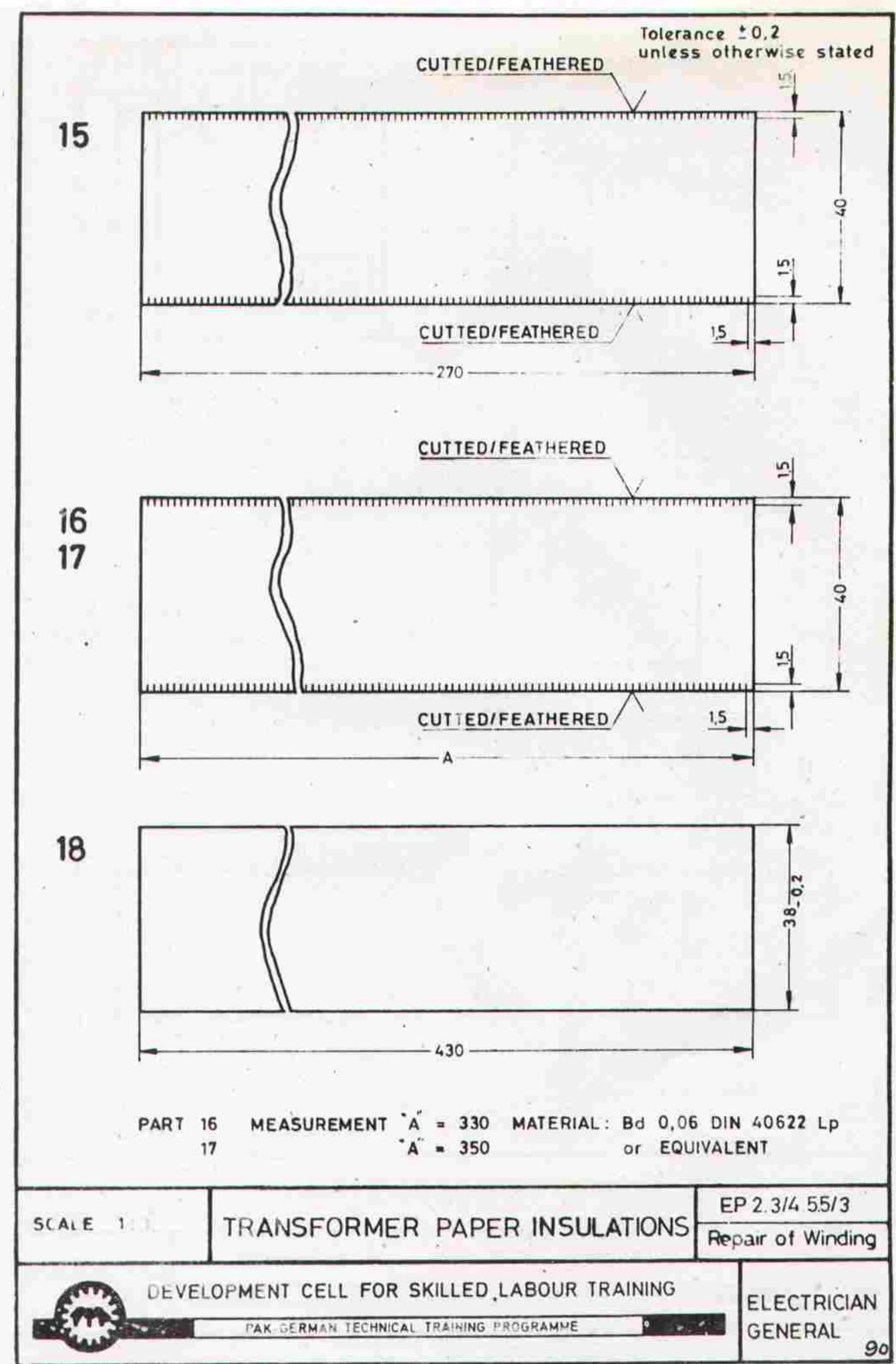
ELECTRICIAN  
GENERAL

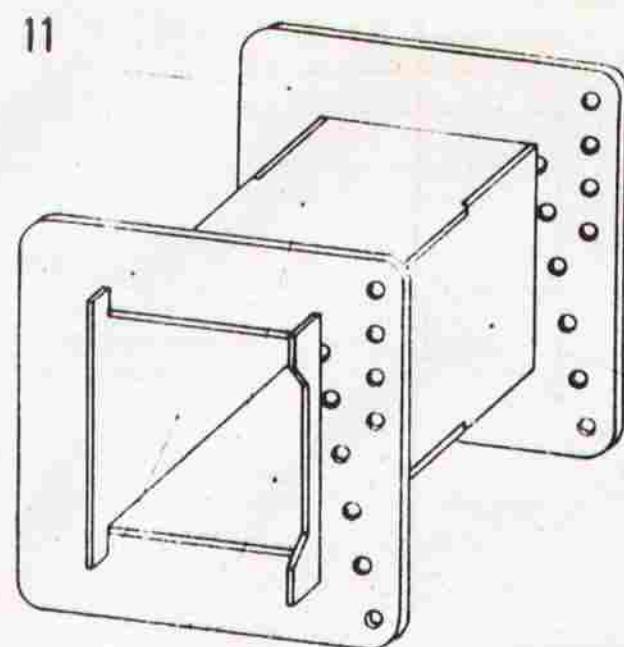
THE VARIOUS TYPES OF CONSTRUCTION ARE DISTINGUISHED BY SYMBOLS, LETTER AND NUMBER.				
CLASS				
A	B	C	D	V
				
MACHINE WITHOUT SHAFT, FRAME WITH LEGS.	HORIZONTAL-SHAFT MACHINES WITH ENDSHIELD-BEARINGS.	AS "B" BUT ADDITIONAL WITH PEDESTAL-BEARINGS.	HORIZONTAL-SHAFT MACHINES WITH PEDESTAL-BEARINGS.	VERTICAL-SHAFT MACHINES WITH GUIDE & RADIAL BEAR.
EXAMPLES OF THE MOST IMPORTANT MOTOR FORMS				
B3	B5	B9	B10	B11
				
B6	V1	V8	V12	V13
				
B7	V3	V9	V10	V11
				
B8	B2	B14	V14	V15
				
V5	V4	V18	V12	V13
				
V6	V2	V19	V16	V17
				
EXAMPLE:				
B 3 MOTOR WITH 2 END SHIELD BEARINGS, FRAME WITH LEGS, FREE SHAFT END & FREE SHAFT END SUITABLE FOR THE ATTACHMENT OF A PULLEY, PINION OR COUPLING. MOUNTING ON FOUNDATION, ETC.				
CONSTRUCTION TYPES OF ELECTRICAL MACHINES			EP 2.3/4.5.6/17	Serv. E. Motors
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME			ELECTRICIAN GENERAL	
				86

 <p>1 ASSEMBLY</p>	 <p>2 SPOOL-PARTS</p>	 <p>3 PAPER INSULATION</p>
 <p>4 SPOOL ASSEMBLY</p>	 <p>5 WINDINGS</p>	 <p>6 CONNECTIONS</p>
 <p>ON DEMAND ONLY</p> <p>SAMPLE</p>	<p>The course "Repair of Windings" should actually consist of motor and transformer repairs as the need may arise for the Training Centre. In case no such work is available timely, the transformer shown on this layout is to be made. The following main skills are trained in this exercise:</p> <ol style="list-style-type: none"> <li>1) preparing spool body out of laminated paper</li> <li>2) cutting insulation paper for different layers</li> <li>3) winding coils, tapped and with different wire diameters</li> <li>4) packing of iron core</li> <li>5) fixing and connecting terminal plate</li> <li>6) testing insulation and function</li> </ol> <p>Parallel to the practical work all necessary informations (incl. calculations) are given in the theory lessons.</p>	
<p>7 LEGS/TERMINALS</p>	<p>LAYOUT</p>	<p>EP 2.1/4.5.5/ Repair of Winding</p>
 <p>DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME</p>		<p>ELECTRICIAN GENERAL</p>



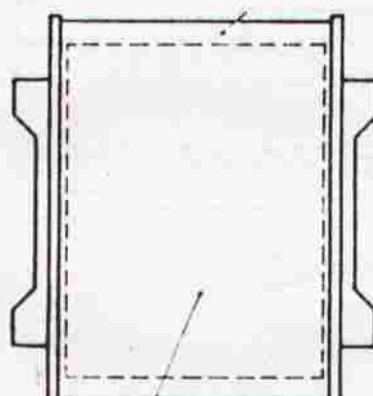






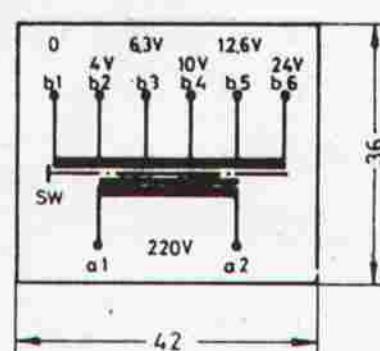
14

13 12



18

19



PART 19 PAPER, WHITE  
80 gr / m<sup>2</sup> 86 DIN 827  
OR EQUIVALENT

SCALE 1:1

TRANSFORMER SPOOL ASSEMBLY

EP 2, 3/4, 5, 5/4

Repair of Winding

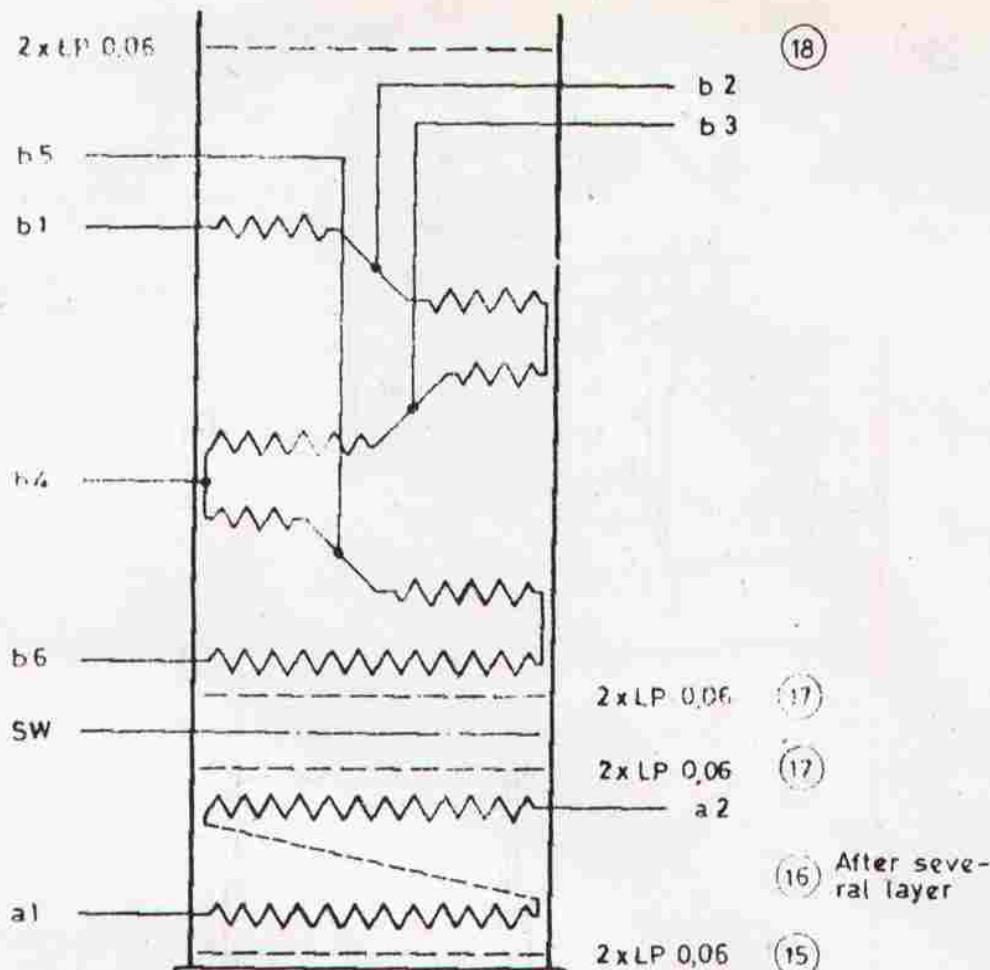


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

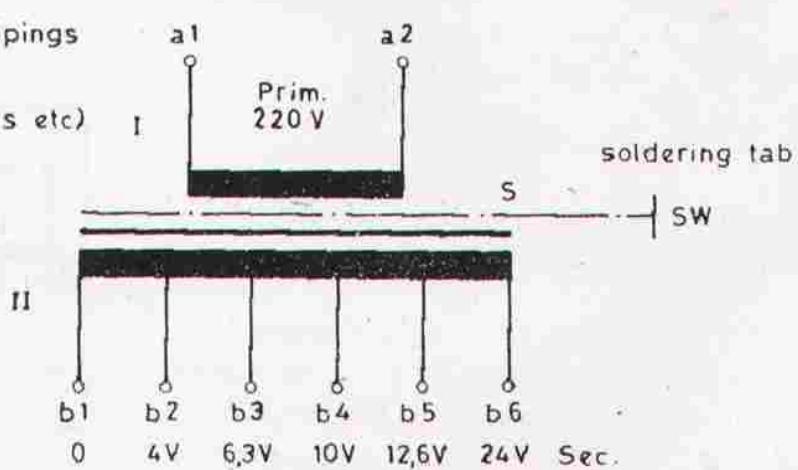
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

91



Mark the winding-tappings  
and ends properly  
(diff. colours, numbers etc)



TRANSFORMER WINDINGS

EP 2.3/4.5.5/5  
Repair of Winding

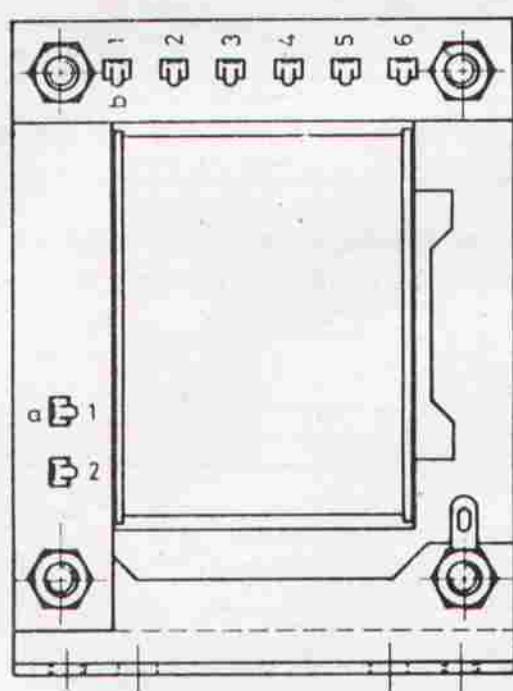
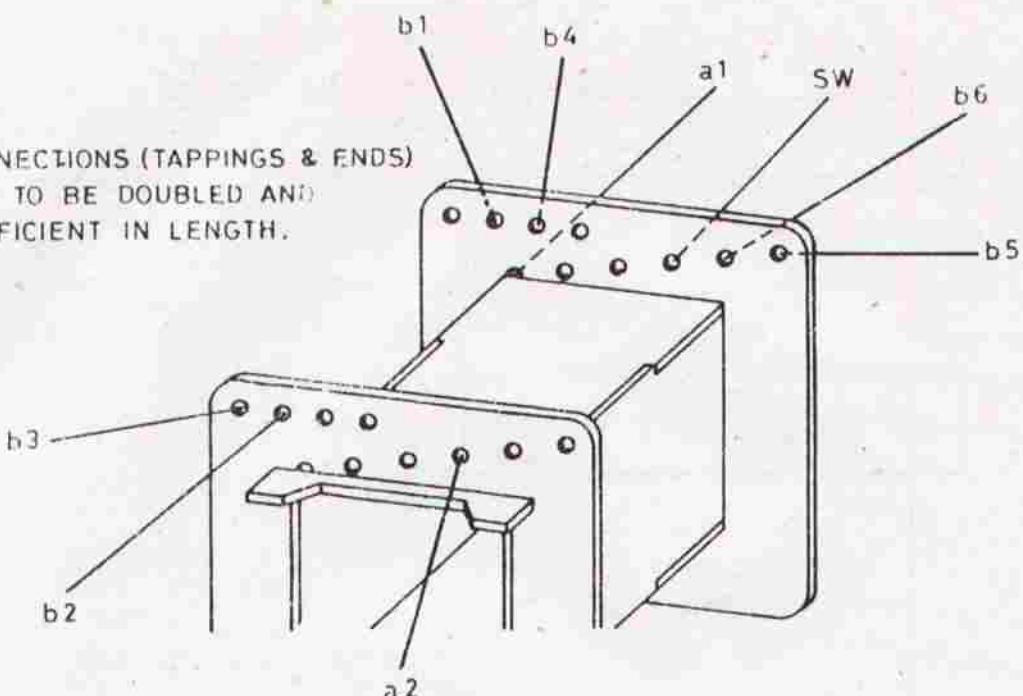


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

CONNECTIONS (TAPPINGS & ENDS)  
ARE TO BE DOUBLED AND  
SUFFICIENT IN LENGTH.



TRANSFORMER CONNECTIONS

EP 2.3/4.5.5/6

Repair of Winding

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN  
GENERAL

93

